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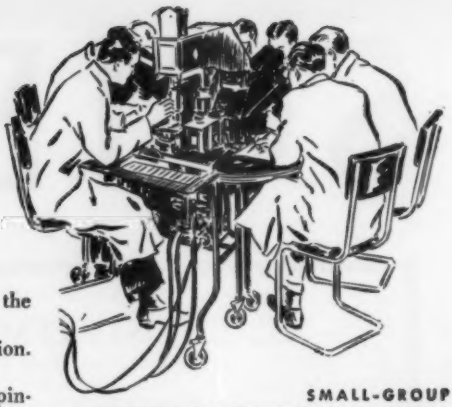

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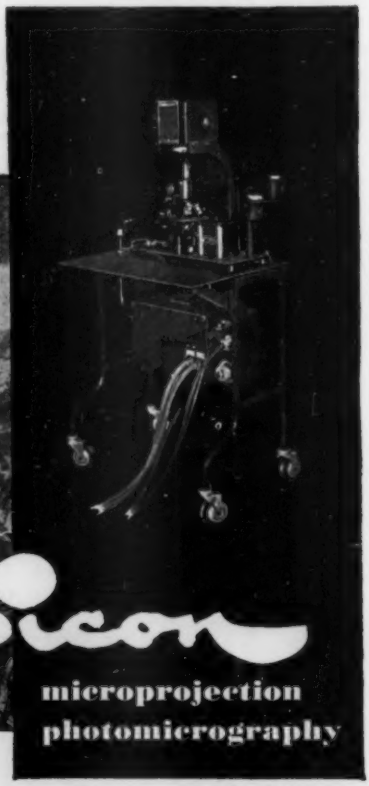

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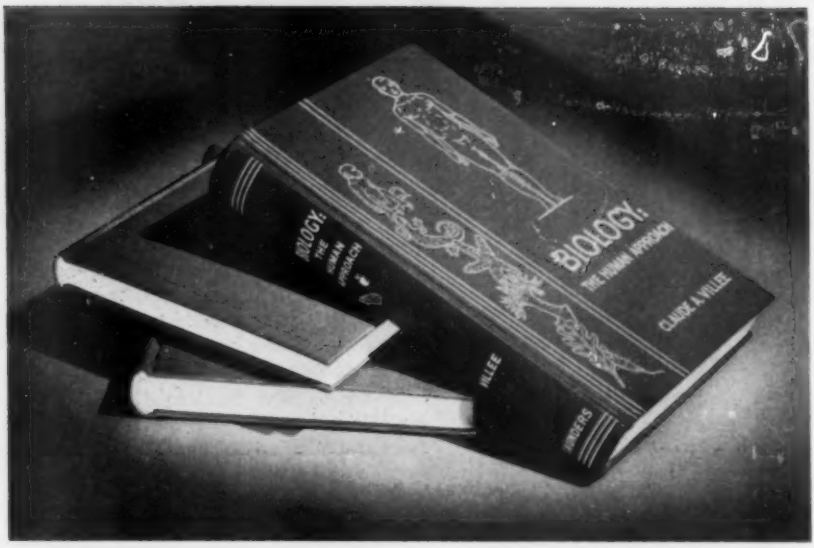

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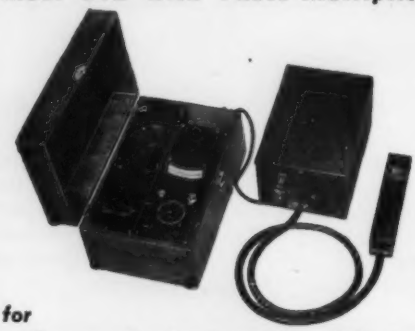

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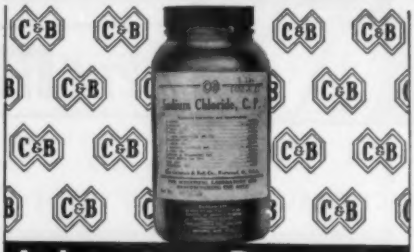

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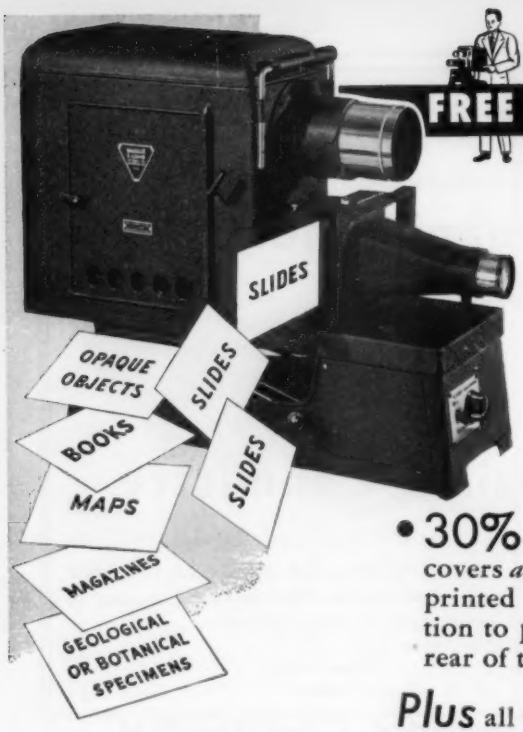

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Scientists and Mobilization

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IN THE OFFICE of Science Service there is a photograph that sums up all the exasperations and gripes of scientists about the use made of them in World War II. It is a picture of one of the young Science Talent Search winners, in Army dungarees, cleaning out a garbage can.

Now that events in Korea have turned the cold war into a warm war, planning for a possible full mobilization becomes more urgent, even while we hope to keep the Korean war from developing into a general conflict. The roles of the scientist, the technician, and the engineer will be vital if full mobilization becomes necessary. Their skills must not again be misused. This time we cannot afford it.

In the days of the American Revolution, fighting was a matter of individual choice. A musket, some ammunition, and a little food—all of them stock items around the house—sufficed for a little fighting. In the Civil War, young men could be drafted, but deferment was possible for those who could pay for substitutes. By this time there were better rifles and more artillery. Technicians were needed to make the trains run and keep the telegraph going, but the role of the scientist was limited almost entirely to experiments with observation balloons and the development of ironclad ships. These, incidentally, were invented by a Korean admiral in the sixteenth century.

In World War I, the United States only partially mobilized. Four million men were in the service, two million went overseas. Fourteen million men served in uniform in World War II. Its climax was a scientific event. The knowledge of scientists, technicians, doctors, and engineers was put to use in such a manner that the entire scientific world nearly used up its stock of basic knowledge. For five years almost everyone who had spent his life in pure research was busy applying his results and the results of others to the problem of winning a war.

On September 18, 1940, President Roosevelt put his hand into a fishbowl and drew out a number. This started Selective Service—based on the principle that those men who were physically and mentally fit had the obligation to defend their country as members of the armed forces. The Army thought that, if enough men were drafted, it would have all the cooks and automobile mechanics and typists and medical orderlies it would need.

In 1940, there were up to ten million unemployed, but the draft, and defense contracts, began taking up the slack. Even so, it was not long before it became evident that, despite the surplus of manpower at the beginning of the war, the supply might have to be husbanded and allocated to keep the civilian economy and war production going while the largest armed force in American history was built up. It also became evident that, in some occupational categories, there was no surplus of manpower; there was a shortage.

It was found that some people with special skills would have to be deferred, and instead of depending on finding the skills they wanted in the general draft pool, the armed forces might have to go after specific people with special skills. This was particularly true of men in scientific, technical, and engineering fields. These problems came up one by one, and, in one way or another, they were met, one by one. In this manner, the nation muddled through. And despite the muddling, the A-bomb was produced.

President Roosevelt tried to solve the problem. In January, 1944, he asked Congress to pass a National Service Act, based on a joint recommendation of the War and Navy Departments and the Maritime Commission:

> When the very life of the Nation is in peril, the responsibility for service is common to all men and women. In such a time there can be no discrimination between the men and women who are assigned by the Government to its defense at the battlefront and the men and women assigned to producing the vital materials essential to successful military operations. A prompt enactment of a national service law would be merely an expression of the universality of this responsibility.

No such act was passed.

In the meantime, for the scientists, confusion reigned. Some were deferred, but had to report back to their draft boards every six months to defend their

deferments. Some were drafted for specific projects, and when the specific tasks were completed—or the military thought they were completed—the scientists found themselves toting guns. Some were just drafted.

On one occasion the Army rushed to the American Psychological Association in desperate need of a hundred competent psychologists. The APA went through its files and supplied the names of one hundred men already in uniform and doing such things as clerical and administrative work, and even KP. Three times the Army built up radar research staffs for specific projects; three times the job was thought to be finished and the staffs were dispersed through the Army. The third staff had neither the experience nor the knowledge to do a proper job.

The general theory was that a young and healthy man wasn't giving his all unless he was in uniform. A clerk typist in the Pentagon got free drinks in Washington bars—a civilian technician back from New Guinea or the Philippines was asked what he was doing out of uniform. But still the war was won and scientists, as scientists, played a crucial part in the victory.

As the cold war developed, many responsible persons in the Defense Department, in civilian branches of the government, and in the scientific societies vowed that, if full mobilization should come, the manpower mistakes of World War II would never be made again. Some of them started to make plans based on the assumption that the cold war might turn suddenly into a hot war, amid the dropping of A-bombs. Immediate full mobilization would be the result, and that was what they were planning for.

But Russian-backed North Koreans attacked, and the nation was faced with the necessity of accomplishing a partial mobilization. Today there are many half-made plans for a full mobilization, the necessity for partial mobilization, and no adequate realization, much less knowledge, of what the basic manpower problems are.

In the Defense Department, for instance, many offices are concerned with some phase of scientific and technical manpower. There is the Personnel Policy Board, the Research and Development Board, the Munitions Board. There are the Army, Navy, and Air Force personnel offices, the Army and Air Force research and development organizations, the Office of Naval Research, and the Bureau of Personnel. In addition, almost every technical service, corps, and bureau have the responsibility for formulating requirements for scientific and technical personnel. There are other offices besides—having to do with specific phases of the Defense Department's manpower needs. Outside this department there is Selective Service, the Department of Labor, and the National Security Resources Board. With semiofficial status is the Office of Scientific Personnel of the National Research Council.

All these agencies are working in the dark so far as two things about scientific, technical, and professional manpower are concerned: They do not know how many people make up the manpower pool, much less what skills they have; and they have made no real estimate of scientific manpower needed for the armed forces, war production, and the civilian economy in a full mobilization. They are further handicapped by the fact that they must make plans for a partial mobilization even as that partial mobilization is going on. And they must try to make sure that partial mobilization does not interfere with plans for full mobilization.

The National Security Resources Board is supposed to have the top authority for determining the uses to which manpower will be put. It advises the President in this and many other fields and, presumably, what it says will be done. It hasn't said very much, but there is evidence that it has done more planning than has been announced. The several versions of the Gurney Bill, recently enacted by Congress, reveal some of the thinking of the NSRB, the Defense Department, and members of Congress on the problem of scientific personnel. As the bill was passed, it gave Selective Service the power, within certain limitations, to draft doctors, dentists, and persons in "allied categories." During its trip through Congress, however, it picked up an amendment, later dropped, which would have permitted the registration and drafting of persons in "professional, technical, scientific, specialist and other occupational categories."

There was considerable argument over this new provision, specifically whether the power to draft should be in the hands of Selective Service or in the hands of President Truman. NSRB favored placing the power to draft persons in the President's hands, on the assumption that he would appoint civilian boards to handle the various occupational categories.

While these provisions were being considered, NSRB revealed to a Congressional subcommittee part of its thinking on how to direct the manpower situation in a full mobilization. This seems to entail a radical revision of our historic methods of drafting men in time of war. Instead of drafting men by order number and hoping, in the general pool, to get the skills needed, NSRB plans envisage drafting some men by occupation. Also, the Defense Department would not make its requests for men directly to Selective Service. Its requests would have to be screened by manpower boards set up by the President and either granted or scaled down, as the over-all man-

power situation would permit. These manpower boards would presumably be composed of outstanding civilians in the occupational categories encompassed in the plan. Selective Service would merely perform the mechanical job of getting men into uniform.

If such a system is to work, it must be based on information. The old roster of scientific personnel was dropped in 1946 because of lack of appropriations to keep it up. A new start has been made at the behest of the NSRB by the Office of Education. People who realized the vital necessity of this kind of personnel data saw in the proposed, and dropped, enforced registration of all scientists and technologists a quick and sure way of getting basic facts, and getting them completely. The roster was seen as one of the main jobs of the new National Science Foundation. As this is written, however, the House has refused to appropriate any money for the foundation. The money is back in the supplemental appropriations bill in the Senate, but the immediate fate of the foundation hangs in the balance.

Within the Defense Department today there is certainly more realization than there was during World War II of how important our scientific manpower resources are, but there is still a tendency to look upon scientists as just another group of skilled men. The Department is naturally eager to get its hands on as many of the best as possible, sometimes without fully understanding just what it is going to do with them.

Outside the government the National Research Council has been most concerned with the manpower problem. M. H. Trytten, director of the Office of Scientific Personnel, is on a committee of the Selective Service Board trying to advise General Hershey about draft policy in connection with scientific skills. This committee is handicapped by a basic provision of the Selective Service Law—that local boards have the say about who is to be drafted. National Selective Service can only advise local boards as to their deferment policies. Dr. Trytten is also participating in meetings with NSRB manpower planners. In both these duties, he is further handicapped by the fact that the NRC is a semiofficial agency of the government. If he or the members of the National Research Council should disagree with a manpower policy set forth by the government, this position makes it difficult for them to protest or to take any independent action.

Scientific societies are only beginning to be concerned with the over-all problem. Sporadically one of them produces some information about the manpower pool in its own particular field or warns that things are drifting and something should be done. But, just as no one in the government has completed a study of the problem, so, too, the scientific societies have taken few, if any, steps to discover the thinking of scientists and technologists about manpower, or to present that thinking with some kind of a concerted voice.

At the moment these specific problems demand serious attention on the part of scientists:

1. What to do about that "significant proportion" of our scientists and engineers who are reserve officers. There are the Research and Development reserve units of the Army, numbering about 3,500 officers. But, in some industrial laboratories, up to 35 percent of the younger men are in the reserves, many of them with armed forces classifications that are unrelated to their civilian skills. The calling up of one or two such men from a laboratory may break up a research team. World War II Naval officers remained in the reserves whether they liked it or not; Army and Air Force reserve officers are there because they wanted to be. But every reservist can see to it that his classification fits his present-day skills. Perhaps there should be a method of transferring some of these reserve officers out of the armed forces into some new unit, which would be empowered to assign scientists to any place where they would be most useful.

2. What position to take in regard to Universal Military Training. Britain, which seems to have handled the problem of skilled manpower more intelligently than has this country, insists that every young man take two years of military training. Sometimes this training is delayed so as not to interfere with a man's education, but whether he be a future Oppenheimer or a future chimney sweep, he must learn how to handle a gun and, more important, learn what the armed forces are all about.

3. What policies to follow in this partial mobilization. One point of view is that present plans for enlarging the armed forces should not affect research and development for defense. Greater numbers of scientists and technicians in uniform will not quicken the progress of weapons development very much, yet, in these days, almost every echelon of almost every arm and branch of the service needs some scientific or technical skill on the operational level.

4. What to do about full mobilization. It must be taken for granted that most scientists, technicians, and professional persons in this country believe: (*a*) That there is a threat to our country and to the kind of civilization that best nurtures scientific progress, and that the threat may require a total war; (*b*) that, if this total war should come, there will be a pressing need for all our present scientific brains and skills, a need to train many more people, and a need to see that these people are used to the nation's best advantage; (*c*) that scientists, men and women, young and

old, have a duty to serve. This duty is the same as that of any man or woman who might be drafted. Scientists expressly do not wish to be thought of as an elite corps above the "common herd," but they believe that, because of the complexity and multiplicity of their skills, they present a special problem.

With these beliefs in common, it is the duty of the scientists themselves to contribute answers to that special problem. Scientists probably would go anywhere, provided they had confidence in the ability of those who give the orders to assess their worth to the country and to use it to the fullest extent. If, however, scientists subscribe to what amounts to a national service act for themselves, there would have to be answers to such problems as wages, hours, and working conditions, reemployment rights, benefits, methods of enforcement, and discipline. It might be argued that an individual research chemist best knows what he can do best for a war effort, and therefore should be allowed to volunteer to do that. This might work, but the rest of the nation, seeing their sons and brothers and husbands without the opportunity to choose between carrying a gun and working in a factory, would not permit that.

It would seem, then, that scientists, technicians, and professional people can only volunteer themselves in a body, and, once they do that, they can lay down certain conditions for their service—conditions designed not for the welfare of the scientists but for the welfare of the nation and of world civilization.

Charles Taylor Vorhies: 1879–1949

Allan R. Phillips
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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE lost a Fellow and a past president (1933) of its Southwest Division, in the sudden death at Washington, D. C., March 10, 1949, of Charles T. Vorhies, head of the Department of Entomology and Economic Zoology of the University of Arizona for many years. Dr. Vorhies had gone to Washington to attend the annual meeting of the National Wildlife Federation, of which he was vice president and chairman of the Committee on Conservation Education.

Born in Henry County, Iowa, September 7, 1879, Dr. Vorhies attended public schools and received the B.S. from Iowa Wesleyan College in 1902. At the University of Wisconsin in 1908, he was the first to receive the Ph.D. in zoology. He was professor of zoology and botany at the University of Utah and served also as acting dean of the Medical School from 1911 to 1913. In 1915 he moved to Tucson and the University of Arizona.

Dr. Vorhies worked steadily for the conservation of natural resources. He was a leader in the founding of the Arizona Game Protective Association, the Tucson Natural History Society, and the Arizona Wildlife Federation, which he served for many years as secretary-treasurer. His approach to conservation was never that of a blind sentimentalist; he put much stress on the importance of continued and unhampered research.

Dr. Vorhies was a man of extraordinary versatility. Originally an entomologist (his graduate studies were on Trichoptera), he later contributed importantly to other fields, especially vertebrate zoology. His leadership in the science of bioecology was recognized in his election as president of the Ecological Society of America in 1939.

The southern Arizona desert was Dr. Vorhies' laboratory, and he made good use of it, both in his research and in his teaching. His first trip to the then remote Santa Rita Mountains was in the summer of 1918; for years thereafter he followed the changing conditions of grass, shrubs, rodents, and rabbits on the Santa Rita Experimental Range. Thus he gradually developed the concept of "animal weeds," the abundance of which was the effect of an overgrazed range rather than its cause. In the earlier years of this research, the automobile was still rather new and the roads were poor. Dr. Vorhies became a skilled mechanic, an ability added to his knowledge of other such unrelated arts as cooking, fishing and other sports, music, and literature, as well as the sciences. He lived an exceptionally full life.

Dr. Vorhies was especially interested in the methods utilized by different animals to control water loss, and in their ability to live under arid conditions with little or no moisture. His most important paper was probably his "Water Requirements of Desert Animals in the Southwest" (*Univ. Ariz. Agric. Exp. Sta. Tech. Bull. 107*, 1945). His work at the Santa Rita Experimental Range produced three other outstanding bulletins, written in collaboration with Walter P. Taylor, on the relation of mammalian numbers and food habits to range forage plants. Their bulletin on *Kangaroo Rats*, published by the U. S. Department of Agriculture in 1922, was a pioneer accomplishment; it combined close observation of the animals' habits and life history with the effect of varying animal populations upon range production. Later bulletins on *Jack Rabbits* (1933) and *Wood Rats* (1940) were published by the University of Arizona's Agricultural Experiment Station.

Ever since the 1870s, the lush grasslands and abundant

game of eastern and northern Arizona had been subjected to heavy abuse by man and his livestock. Eventually it became clear that a given amount of land cannot support an unlimited number of cattle. A gently sloping area of former grassland below the Santa Rita Mountains, 30 miles south of Tucson, was set aside for experiments to determine better methods of range utilization. It was here that Dr. Vorhies found the answers to the questions of what part, if any, the native rodents and rabbits had played in the transformation of verdant pasturage into barren lands of thornbush, cactus, deep gullies, and poisonous weeds. After long study, he and Taylor concluded that "contrary to our original opinion, detailed studies indicate that it is not true that jack rabbits are most abundant where the grass is best." Instead, they found that rabbits preferred poorly grassed areas, and that "under conditions of overgrazing and of misapplied control of predators, there is almost sure to be a jack rabbit and rodent problem. . . . In small or moderate numbers the jack rabbit may be of neutral or even beneficial status on all but cultivated lands." The wood rat was found to be even less harmful; large-scale control was considered unnecessary and undesirable.

Of the greatest interest were Dr. Vorhies' discoveries on the microclimates of desert mammals. For example, the ground squirrel *Citellus tereticaudus* can always retire to a burrow whose mean maximum temperature never exceeds 85° F at a depth of 4 feet, even though the mean maximum soil surface temperature is over 150° F for months, with individual temperatures reaching almost 170° F! Nor do mammals avoid such areas of extreme temperatures. "A comparison of the climate of the mesquite forest with the adjacent desert mesa shows a less extreme climate in the forest, especially as to atmospheric humidity and soil-surface temperature. Nevertheless more mammals, both as to species and individuals, live in the desert environment."

With his students, Dr. Vorhies had great patience and understanding, but he saw to it that they learned to think for themselves. He did not try to cram impossible amounts of trivial details into their heads momentarily, but gradually, by readings, discussions, and field observations, the students came to see the complexity and interdependence of all nature, the need of thought before action, and the vast amount of research still to be done.

Coming on the eve of a retirement that would have freed him from many routine pressures, Dr. Vorhies' death was a loss to science and to the cause of intelligent land use. His name is perpetuated in a phytomonad protozoan, *Chlamydomonas vorhiesi* Jones; a tarantula, *Delopelma vorhiesi* Chamberlin and Ivie; and a little-known wren, *Troglodytes brunneicollis vorhiesi* Brandt. He is survived by his wife, Georgia Ann (Smith) Vorhies, and by a son, Charles Tuttle Vorhies.

Gregory B. Mathews, S.V.D.: 1903–1949

Harold W. Rigney

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Father Gregory B. Mathews, S.V.D., Ph.D., dean of the College of Agriculture, and professor of botany at the Catholic University (Fu Jen) Peking, China, died of a heart attack in his living quarters at the university on the morning of February 4, 1949. Father Mathews was born at Peterswalde, West Prussia, Germany, on October 14, 1903, and attended the Gymnasium of the Holy Cross College at Neisse in Upper Silesia. He pursued his philosophical studies at St. Anselm's in Rome and studied theology at the University of St. Gregory in the same city. He was ordained a priest in 1932. In 1934 he joined the staff of the Catholic University, Peking, lecturing on botany. Later he pursued graduate studies in botany at the University of Chicago, where he took his Ph.D. in 1939, specializing in paleobotany.

In 1946, the Department of Agriculture was established at the Catholic University, Peking and entrusted to his care. The department was later extended into a college.

Father Mathews was noted as a good teacher and a tireless worker. He published textbooks and syllabi, as well as many papers, most of them dealing with paleobotany. He had worked many years preparing a Bibliography of Paleozoic and Mesozoic Flora of China and Korea. The research work on this project was finished, and the manuscript almost ready for the press, at the time of his death. Mr. Cheng Pao Shan, who assisted him in this work, is putting the final touches to the manuscript.

The passing of Father Mathews is a great loss to the scientific circles and life of Peking.

Technical Papers

Vitamin B_{12}: The Identification of Vitamin B_{12} as a Cyano-Cobalt Coordination Complex

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Vitamin B_{12} contains one cyano group bound coordinatively to the cobalt atom. Vitamin B_{12a}, however, does not contain this group.

During an oxidation of vitamin B_{12} in dilute sulfuric acid solution at 0° C with potassium permanganate, the characteristic odor of hydrogen cyanide was noted. The solution was distilled, and the distillate examined for the presence of cyanide, using the copper-benzidine (*2*) and the ferrous sulfate tests (*3*). Both were positive. In another oxidation, carried out in a closed system, a solution of 49.1 mg of vitamin B_{12} in 5 ml of 0.75 *N* sulfuric acid was stirred in an ice bath during the dropwise addition of 3.5 ml of 2% potassium permanganate solution. The reaction mixture was warmed to 75°, and nitrogen was bubbled through the solution. The exit gases were passed into dilute sodium hydroxide solution. A volumetric determination of the hydrogen cyanide evolved (*5*) gave a value of 0.66 mg, corresponding to 0.67 mole/mole of vitamin B_{12}.

Hydrogen cyanide was also liberated readily upon heating solutions of vitamin B_{12} in hydrochloric or aqueous oxalic acid. In the presence of saturated aqueous oxalic acid, 0.96 mole of hydrogen cyanide was liberated per mole of the vitamin when the solution was boiled under reflux for 5 hr. Due to simultaneous hydrolysis of the cyanide, its yield was somewhat lower when hydrochloric acid was employed. No cyanide could be detected when vitamin B_{12} was warmed with dilute sulfuric acid under the same conditions used for its liberation by hydrochloric or oxalic acid.

Since chloride and oxalate are known to coordinate readily with cobalt, while sulfate shows only a slight tendency to enter in coordination complexes with this metal (*7*), it seems probable that the cyanide group in vitamin B_{12} is a member of the cobalt coordination complex, and that it may be displaced from the coordination sphere by anions with strong coordination tendencies.

No cyanide could be detected when pure vitamin B_{12a} was treated with oxalic acid solution. Vitamin B_{12} possesses an absorption band at 4.69 μ in the infrared region, which may be ascribed to the presence of a carbon-nitrogen triple bond; but this band does not appear in the absorption spectrum of vitamin B_{12a}. Vitamin B_{12a} and vitamin B_{12b} are apparently identical (*4*); and the absence in the infrared spectrum of vitamin B_{12b} of a band that is present at 2,140 cm^{-1} in the spectrum of vitamin B_{12} has been observed by others (*1*). It has been reported (*3*) that vitamin B_{12a} does not differ greatly in its composition from vitamin B_{12}. One significant difference is the presence of a coordinatively bound cyano group only in the latter compound.

The extreme lack of toxicity of vitamin B_{12} (*6*) indicates that the cyano group is tightly bound within the coordination complex. Dose levels of 1,600 mg/kg, both intraperitoneally and intravenously in mice, produced no deaths or toxic manifestations. This dose level corresponds to 112,000,000 times the daily human dose of 1 μg of vitamin B_{12} listed in the *U. S. Pharmacopeia.*

[1] The authors are indebted to N. R. Trenner and his associates for the infrared studies on vitamins B_{12} and B_{12a}.

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Vitamin B_{12}: Reactions of Cyano-Cobalamin and Related Compounds

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It has been found that a cyano group (*1*) is present in the vitamin B_{12} cobalt coordination complex, but not in

[1] We are indebted to R. N. Boos for titrations and analytical data, to James P. Dux for determination of refractive indices, to David Hendlin, Margaret Soars, and John Lally for microbiological assays, and to T. J. Webb and J. B. Conn for their advice and helpful discussions.

vitamin B_{12a}. Further investigation has led to the discovery of some new reactions of structural interest.

Addition of cyanide ions to a solution of vitamin B_{12a} yielded vitamin B_{12}, which was obtained crystalline and identified as described herein. Since an aqueous solution of vitamin B_{12a} has a pH of about 9 and behaves on titration as a weak base, it appears that a hydroxo group has replaced the cyano group. This conversion of vitamin B_{12a} to vitamin B_{12} shows that, in the formation of vitamin B_{12a}, the only structural change is a replacement of the cyano group.

TABLE 1

REFRACTIVE INDICES*

	α	β	γ
Chloro-cobalamin	1.620 ± 0.002	1.628 ± 0.002	1.634 ± 0.002
Product from $H_2S + B_{12}$	1.600 ± 0.002	1.648 ± 0.002	1.674 ± 0.004
Hydroxo-cobalamin	1.580 ± 0.002	1.640 ± 0.002	1.656 ± 0.002
Sulfato-cobalamin	ϵ 1.606 ± 0.002 ; ω 1.640 ± 0.002		

* Samples dried *in vacuo* at *ca* 25° C.

New nomenclature is needed to describe the large number of modifications of vitamin B_{12} that result from similar replacement reactions. The name cobalamin designates all the vitamin B_{12} molecule except the cyano group, and by convention (7) vitamin B_{12} becomes cyano-cobalamin, and vitamin B_{12a}, hydroxo-cobalamin.

Three and seven-tenths mg of hydroxo-cobalamin (vitamin B_{12a}) was dissolved in 2 ml of water. To this solution was added 0.5 ml of a solution containing 6.6 mg of potassium cyanide. The mixture was adjusted to pH 5–6 with dilute hydrochloric acid, and the vitamin B_{12} was extracted with two 1.5-ml portions of a solution of phenol-carbon tetrachloride (1–7 by volume), which was equilibrated with water. The extracts were combined and then extracted four times with 1-ml portions of water that had been equilibrated previously with the phenol-carbon tetrachloride solution. The phenol-carbon tetrachloride solution was then diluted with *ca* 12 ml of carbon tetrachloride, and the vitamin B_{12} was extracted with two 1-ml portions of water. The combined aqueous extracts were washed with ether to remove traces of solvent and then evaporated to dryness *in vacuo* at 25°–30° C. The residue was dissolved in *ca* 0.5 ml of water, and the solution was diluted with *ca* 12 ml of acetone. After the solution stood for about 30 min, slender red needles of cyano-cobalamin (vitamin B_{12}) began to crystallize. The crystals were separated by centrifuging, washed with acetone and dried; yield, 2.3 mg. The absorption spectrum showed maxima at 2,780A, 3,610A, and 5,500A, which is characteristic of vitamin B_{12}.

Reaction of vitamin B_{12} with sulfurous acid gave crystalline sulfato-cobalamin (K, 2.5).[2] Reaction of vitamin B_{12} with hydrogen sulfide does not remove the cobalt, but introduces a sulfur-containing group that does not appear to be sulfido, sulfito, or sulfato; this product is crystalline (K, 0.36. Anal. Found: S, 2.2). Vitamin B_{12a} reacted with chloride ions to give chloro-cobalamin (K, 2.0. Anal. Found: Cl, 2.6). Chloro-cobalamin reacts in water with potassium cyanate to give cyanato-cobalamin (K, 0.8).

Other information characterizing these new products are refractive indices and microbiological assays, which are summarized in Tables 1 and 2. Cyano-cobalamin has

[2] Distribution coefficient, C_w/C_c, determined in carbon tetrachloride-phenol (7–1 by volume)-water.

TABLE 2

MICROBIOLOGICAL DATA

	L. lactis (units/μg)	
	titrimetric (2)	cup (3)
Chloro-cobalamin	7,000	10,400
Product from $H_2S + B_{12}$	6,600	12,300
Hydroxo-cobalamin	7,700	11,000
Sulfato-cobalamin	6,300	10,900
Cyano-cobalamin	11,000	11,000

activity as a growth-promoting factor for *Lactobacillus lactis* equivalent to 11,000 LLD units per μg (6). The microbiological activity values of vitamin B_{12a} appear to be dependent on the conditions of assay and vary from 30–100% of that of vitamin B_{12}. The titrimetric method values that are given were obtained by autoclaving the sample with the assay medium and, under these conditions, possess about 70% of the activity of vitamin B_{12} (4).

These analogues—for example, chloro-cobalamin, cyanato-cobalamin, sulfato-cobalamin, and the crystalline sulfur-containing complex from hydrogen sulfide—have also been converted to crystalline vitamin B_{12} by reaction with cyanide ions.

Comparative data show that vitamin B_{12a} and vitamin B_{12b} appear to be identical (5). When 0.3 mg of vitamin B_{12b} (Lederle NP-92-58-4)[3] in water was treated with cyanide ions, 0.2 mg of crystalline vitamin B_{12} resulted.

The essential differences in the spectra of vitamin B_{12a} and related compounds appear to be only those brought about by the pH conferred by the ion associated with the particular analogues. They are exemplified (5) by the change in the spectrum of vitamin B_{12a} with pH change.

Further details on the preparation of these and other members of the vitamin B_{12} group that have been made from vitamins B_{12} and B_{12a} will be submitted for publication.

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[3] Furnished through the courtesy of T. H. Jukes, of the Lederle Laboratories Division of the American Cyanamid Company.

Preliminary Report of X-Ray Effects on the Nematode *Rhabditis strongyloides*

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Numerous articles have appeared in the literature dealing with the effects of irradiation of nematodes where the emphasis has been on lethal effects. In our investigation we are concerned with the nonlethal effects of the characters of adult individuals of a bisexual nematode, *Rhabditis strongyloides*. This worm appears to be different, in respect to observable changes, from animals, plants, and bacteria used in conventional genetic studies.

The nematodes used in this study were obtained from Norman D. Levine, of the College of Veterinary Medicine, University of Illinois. These roundworms came from skin lesions resembling scabies found infesting a dairy cow on a farm near Lincoln, Illinois.

Several worms were obtained from under scabs and introduced to sterile nutrient agar plates poured about 1 mm thick. About one week later these Petri dish cultures were sprinkled lightly with granulated blood fibrin. The following day they were teeming with worms in all stages of development. By the use of blood fibrin it was possible to control the production of worms at will and to maintain a pH of about 8 in the culture. A new generation of worms can be produced every 3 days. Some cultures were allowed to dry slowly at room temperature. After several weeks or months in the dry state they revived within a few hours whenever a film of water was added. Dry cultures were also scraped from the Petri dishes as a dry flakelike dust and sprinkled lightly on fresh nutrient agar. Within 24 hr the worms revived. From the above stocks, cultures were taken for the purpose of studying irradiation effects.

Irradiation of wet cultures

On February 14, 1948, a wet culture was separated into four portions and exposed as follows: 100 r, 400 r, 1,600 r, and 6,400 r, respectively, with 200 kv, no filter, dosage rate of 112 r/min. The portions were then cultured on fresh agar and observed each week until May 14, 1948, when they were again recultured. Since no changes in the worms were observed, they were transferred to fresh culture media every 3 months until December 18, 1948. Control cultures were given the same culture treatment. By supplying a sprinkling of blood fibrin to the cultures, it was possible after successive generations to increase the size of female worms from about 1.5 mm in length to 2.5 mm. Old females change from the oviparous to the ovoviviparous condition. No structural changes were noted either in the controls or in the irradiated worms.

Another set of wet cultures was exposed on December 18, 1948, to 10,000 r, 20,000 r, and 40,000 r units, respectively, at 100 kv, no filter, dosage rate of 1,600 r/min. Observations were made as follows: December 20, 1948, no changes were noted in culture No. 1, given 10,000 r units. Additional blood fibrin was sprinkled on the worms December 28, 1948, and they were unchanged the following day. When examined again January 7, 1949, the irradiated worms and controls were normal.

Culture No. 2, which had been given 20,000 r units, was treated like Culture No. 1, and no changes were observed until January 8, 1949, when many larvae appeared with marked changes in the refractive index of the rhabditin granules of the intestine. Normally the intestine of *Rhabditis strongyloides* appears dark throughout its length in transmitted light but is white in reflected light. The chemical composition of rhabditin is unknown, but it is the substance associated with this color change. Some larvae had a normal black band in the middle of the intestine, with the ends clear; others were light in the middle and dark on the ends, or dark at one end and light throughout the rest of the length, or with scattered patches of dark throughout the entire length, or completely light, like "dauer" larvae. Such larvae belonging to other species have been reported to be carried under the elytra or attached to the integument of certain insects, such as dung and carrion beetles.

Culture No. 3, which was given 40,000 r units, received the same treatment as Culture No. 1, but by December 20, 1948, no adult worms were to be found, and only a few active larvae. On December 28, 1948, young males and females appeared that seemed to be completely sterilized, as the reproductive systems were quite vacuolate. The following day numerous worms of both sexes were seen with looped or spiral-like intestines. Eggs appeared in assorted sizes, some with very thin shells, others with heavy albuminous coats similar to ascaris eggs. On January 5, 1949, numbers of worms similar to "dauer" larvae were noted on the cover of the Petri dish. Changes in rhabditin granules appeared similar to those in Culture No. 2. The dauerlike larvae had an unshed molt retained like a sheath, the intestines were light, and the bulbus of the esophagus was greatly reduced.

Irradiation of dry cultures

Dry cultures, which had been saved from controls during the year 1948, were separated into 4 portions and exposed to 10,000 r, 20,000 r, and 40,000 r units, respectively, at 100 kv, no filter, dosage rate of 2,750 r/min. Each culture was then sprinkled on a fresh sterile nutrient agar plate on February 21, 1949. Six days later all 3 cultures were teeming with adults, larvae, and eggs on the surface of the agar. The same effects were obtained with 40,000 r units in the dry state as were previously obtained with 20,000 r units on wet cultures.

Cultures derived from irradiated individuals of *Rhabditis strongyloides* contained many (up to about 50%) individuals with visible changes. These changes are the same as occur occasionally in normal cultures. The radiation-induced changes occurred in cultures many generations removed from the irradiated animals. We are therefore dealing with genetic effects. The animals were kept in crowded mass cultures; thus, the radiation-induced genetic changes observed have been perpetuated for generations in a highly competitive milieu. The genetic response to irradiation of nematodes is strikingly different from that observed in insects, mammals, and various

plants and bacteria, in all of which manifest changes in fully viable individuals are rather exceptional.

Radiation effects in nematodes have been studied before, but the emphasis has not been on the characters of the adult individuals, as in our investigation. Alicata and Burr (*1*) tried to kill larvae of *Trichinella spiralis* by irradiation with radiocobalt. They found that a dose of 2,000 r per day was not lethal. The eggs of *Parascaris equorum* have been the object of numerous investigations with irradiation, as in the work of Zuppinger (*2*). However, the effects studied were mainly killing and delay of mitosis. As far as we know, changes in the adults like the ones we observed have not been previously described.

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The Order of Utilization of Phosphorus Compounds in the Egg by the Chick Embryo[1]

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In the course of some experiments in these laboratories on autoradiography with P^{32}, we observed that early chick embryos invariably showed a higher deposition of P^{32} than later ones. The result could indicate that the embryo first utilizes the inorganic phosphorus available in the egg for building the phosphorus compounds in its tissues, for we injected P^{32} as NaH_2PO_4. To check on this hypothesis we gathered data on the specific activity of various phosphorus fractions in the embryo.

TABLE 1

Specific Activity*

	Average acid soluble	Residual phosphorus	Phosphatide
2-day embryo	10.71	20.3	1.67
4-day "	5.45	8.94	0.50
6-day "	2.23	0.59	0.59

* Specific Activity $= \frac{\text{Counts/}\mu\text{g of phosphorus}}{\text{Counts/ml of original } NaH_2PO_4 \text{ sol}} \times 10^4$

New Hampshire brown eggs from the University of Maryland farm were set aside in three groups to be incubated in a modified Buckeye incubator for 2-, 4-, and 6-day periods. Each of these eggs had received 0.1 ml of an isotonic solution of NaH_2PO_4 with an activity of 0.2 μc. The injections were made from a 1-cc tuberculin syringe with a ½-in. No. 27 needle through a small hole, drilled in the blunt end of the egg into the air chamber while the egg was supported in a cotton-filled cup. We used a No. 54 drill in a small table drill press controlled by a foot pedal. The eggs were sealed with sterile paraffin. The isotonic NaH_2PO_4 was prepared from radioactive KH_2PO_4, procured from Oak Ridge, following standard procedure. The radioactivity of the solution was determined by comparison with Bureau of Standards Ra D + E standard, No. 26. All radioactivity measurements were made with a mica end-window Geiger-Müller tube, window thickness 3.0 mg/cm², feeding into a Tracerlab Autoscaler. The experimental technique was essentially that reported by Branson *et al.* (*1*).

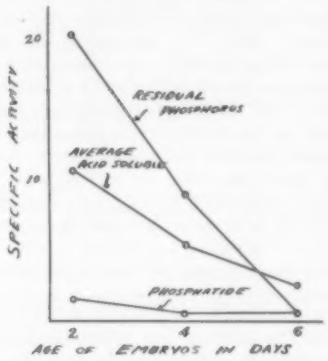

Fig. 1. Behavior of the specific activities for 3 phosphorus fractions.

At the end of each incubation period the embryos were removed, frozen immediately in liquid air, and ground to a powder. The powder was extracted several times with cold 10% trichloracetic acid, followed by extraction with cold 5% acid. Separation of the acid solubles into their component parts was not carried out. However, the residue from the acid solubles was extracted with alcohol and ether to remove nucleoproteins and phosphatides. The scheme of separation was based on that of Hevesy *et al.* (*2*).

The phosphorus was determined spectrochemically according to the procedure of Kitson and Mellon (*4*). The results are given in Table 1 and Fig. 1. The values in Table 1 are the averages of 15 2-day old embryos, 11 4-day old embryos, and 11 6-day old embryos, respectively. The embryos were pooled prior to chemical extraction to insure sufficient material for proper handling.

The eggs to be used for autoradiography were prepared in the same manner. The viable embryos were dropped immediately into liquid air. They were allowed to thaw, and the material was prepared following method C of Holt *et al.* (*3*). Ten micron sections were used on Agfa Triple-S Pan film. The sections were given a thin coat of 1% collodion to avoid sticking and the production of artifacts.

Fig. 1 shows that the specific activities of the 3 phosphorus fractions decrease rapidly as the embryo ages. This behavior can be understood only on one tenable hypothesis: the embryo first uses the small amount of

[1] This work has been assisted by the Office of Naval Research, and Research Corporation of New York.

inorganic phosphorus available in the egg to build the phosphorus compounds. (The alternative possibility that the embryo selectively absorbs the P^{32} over the P^{31} requires a renunciation of the isotope tracer technique.) The hypothesis is consistent with earlier experiments in our laboratory and the pioneer work of Hevesy *et al.* (*2*).

The data enable us to make a more specific suggestion as to the mechanism operating in this process. Hevesy *et al.* (*2*) injected hexosemonophosphate into the egg. They found that all the phosphorus fractions in the 14-day embryo were labeled, but that only the inorganic phosphorus and the hexosemonophosphate of the yolk were labeled. We believe that these results and our findings indicate the operation of the following mechanism:

The organic phosphorus compounds are hydrolyzed outside the embryo (possibly by a phosphatase released by the embryo or by the activation of a phosphatase by the embryo), and the inorganic phosphorus produced is then taken up by the embryo. Otherwise, our data would require that both the organic phosphorus and the inorganic phosphorus enter the embryo, since we have repeated the experiment proving that inorganic phosphorus does not label the organic phosphorus when radioactive inorganic phosphorus is stirred with the yolk and permitted to stand at room temperature for several hours. This experiment shows that there is in the yolk no equilibrium of the type: organic phosphorus $\leftrightarrows$ inorganic phosphorus. In addition, the larger amount of phosphorus entering the embryo must be from the inorganic fraction, since the specific activities of all fractions in the 2-day embryo are roughly 4 times those in the 6-day embryo. Kugler showed that, of the 64.6 mg of lipoid phosphorus in the yolk, only 25.1 mg remained there on the 20th day of incubation. Only 7.87 mg of lipoid phosphorus was in the embryo. Thus 31.63 mg had been hydrolyzed to yield inorganic phosphorus. These findings under an alternative mechanism would require the unnecessary transport of 31.63 mg of lipoid phosphorus into the embryo, with the subsequent release of a considerable fraction of the inorganic phosphorus back into the yolk.

This proposed mechanism is consistent with all the information and does not necessitate the assumption that relatively large amounts of inorganic phosphorus must leave the embryo. Although these initial experimental results are not conclusive, they do support the proposed scheme. Whether the embryo does use the organic phosphorus directly has not been determined. It looks as if that point may be difficult to establish. Additional experiments to check further on the proposed mechanism are in progress.

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A Paper Chromatographic Study of Ferritin and Apoferritin Hydrolysates[1]

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During the course of experimentation on some chemical properties of the iron-protein, ferritin, and the role of ferritin in iron absorption, the amino acid composition of ferritin and of its protein moiety apoferritin was studied. Conflicting data concerning the amino acid components of ferritin and apoferritin were reported by Kuhn *et al.* (*4*) and Tria (*6*). Recently, however, Mazur and Shorr (*5*) reported the partial amino acid composition of horse spleen ferritin and apoferritin, which showed identical amino acid values on the basis of nitrogen content.

Fig. 1. Paper chromatogram of an apoferritin hydrolysate.

The two-dimensional chromatographic method used in these studies was essentially that of Consden, Gordon, and Martin (*1*) as modified by Dent (*3*). The solvents employed were phenol, saturated with water, and a mixture of 2,4,6-collidine and 2,4-lutidine, saturated with water. Whatman No. 1 filter paper was used. The amino acids were detected by spraying the papers with 0.1% ninhydrin in *n*-butanol to which an excess of water had been added. The color was allowed to develop for 24 hr, and the amino acids were identified by their relative positions and by comparison with a reference map prepared by Dent (*3*).

The chromatogram thus obtained with 50 μl of horse

[1] Material used in this study was taken from a thesis submitted by B. W. G. to the University of Rochester in partial fulfillment of the requirements for the Ph.D. degree in biochemistry. This paper is based on work performed under contract with the U. S. Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, N. Y. The authors wish to express their appreciation to Kurt Salomon for his interest in the investigation.

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spleen apoferritin hydrolysate, equivalent to 0.8 mg of protein, is shown in Fig. 1. The hydrolysis was carried out with 6*N* HCl at 100° C for 18 hr. The following amino acids were present as ninhydrin-reactive substances: tyrosine, phenylalanine, the leucines, valine, glutamic acid, aspartic acid, glycine, serine, arginine, lysine, cystine (as cysteic acid), and methionine. Threonine was observed in trace amounts on chromatograms employing larger quantities of protein. Histidine was not observed in Fig. 1 because of its low sensitivity to the ninhydrin reagent, although its presence was reported by Mazur and Shorr (*5*). The relative quantitative estimations are in agreement with those given by Mazur and Shorr (*5*), except that, in addition to the amino acids listed by these authors, aspartic acid, glycine, serine, and threonine were detected chromatographically.

Paper chromatography of horse spleen ferritin showed the same amino acid composition as that of apoferritin but, in addition, it was observed that some of the iron, liberated by hydrolysis, had migrated in the phenol direction as a definite yellow spot. A chromatogram of ferric iron alone did not show this movement. It was found that the migration of iron on the chromatogram of the ferritin hydrolysate was not characteristic of ferritin, for identical movement was seen in a paper chromatogram run on Amigen (commercial pancreatic casein hydrolysate), to which ferric iron had been added in amounts approximating that contained in ferritin. In all these chromatograms, however, the amino acids moved to their relative positions with the collidine-lutidine solvent, whereas the iron remained on the phenol abscissa. Thus, the iron appears to be conjugated with one or more of the amino acids in the phenol run, but the association is disrupted by the collidine-lutidine solvent.

One-dimensional chromatograms (phenol solvent) of several single amino acids with added iron showed that all the amino acids tested were capable of moving iron from the starting point in varying degrees. Each amino acid could be classified according to the amount of iron it carried (Table 1).

TABLE 1

Amino acid	Amount of iron carried by the amino acid*
Histidine	++++
Alanine	++
Arginine	++
Isoleucine	++
Leucine	++
Lysine	++
Phenylalanine	++
Tyrosine	++
Valine	++
Threonine	+
Serine	+
Aspartic acid	+
Glutamic acid	+
Glycine	+
Control (iron)	No migration

* The system of grading, ++++ to +, is used to designate the amount of iron carried by the amino acid.

Thus, the iron spot, noted on the paper chromatograms of hydrolyzed ferritin and Amigen + iron, is probably due to the fact that such amino acids as histidine, the leucines, arginine, lysine, phenylalanine, and valine are associated with a considerable amount of iron and move to about the same position in phenol.

It is also apparent from Table 1 that histidine conjugates a greater quantity of ferric iron than do other amino acids. Furthermore, the strong affinity of histidine for iron has been reported (*7*). It is possible that a correlation might be found between the histidine content of proteins and their iron-binding capacity.

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Mass Mortality of Fish Associated with the Protozoan *Gonyaulax* in the Gulf of Mexico[1]

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This is the first reported observation of the concurrent appearance of a red tide, luminescent water, and immense numbers of the dinoflagellate protozoan, *Gonyaulax*, with mass mortality of fish on the eastern coast of North America. The episode occurred in the summer of 1949 in a salt water lagoon known as Offatt Bayou along Galveston Island (Figs. 1, 2). Three previously unreported associated biochemical phenomena were revealed by water analyses and offer new clues to the still-undiscovered mechanism of destruction of fish.

From time to time since 1902, comparable but more extensive destruction of fish has been concomitant along the west coast with the appearance of dinoflagellates (particularly *Gonyaulax*), luminescence, and the rusty red water commonly called a red tide (*7, 14*). Similar losses of marine life have occurred in Florida (*4*), but another dinoflagellate, *Gymnodinium*, has been incriminated. Historically, *Gonyaulax* has not only been associated with the mass mortality of marine life, but the species *G. catenella* is known to be the cause of the disastrous poisonings in man by mussels along the Pacific coast (*10–14*). Since 1941, when there were 346 cases with 24 deaths, there have been only a few cases, because state laws forbid the gathering of shellfish during the

[1] Acknowledgment is made of the assistance of R. Z. Finchum and O. K. Mullen, of the Texas Game, Fish and Oyster Commission, in the collection of samples and in making field observations.

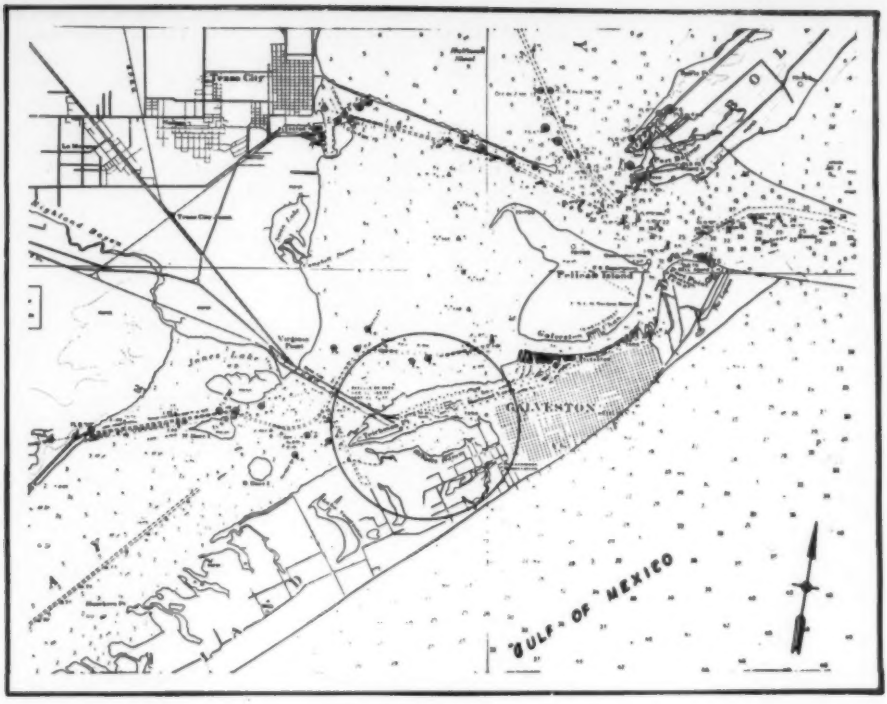

FIG. 1.

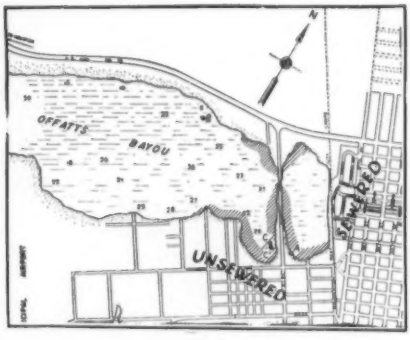

FIG. 2.

season when *G. catenella* may synthesize the poison. The toxin, which is approximately 10 times as potent as strychnine for mice (*11*), is transmitted to man only in shellfish because in the latter the viscera (in which the poisonous protozoa are concentrated), as well as the muscular portion of the fish, are eaten. Poisonings caused by *G. tamarensis* have also been reported from Nova Scotia along the North Atlantic (*2*). Oysters can concentrate the poison but have caused little trouble, because their harvesting during the summer months was popularly abandoned long ago.

Since oysters are the only edible shellfish in the vicinity of Galveston, it is not surprising that there are no records of local poisonings. It is probable, however, that red tides have occurred more often than they have been reported. In fact, when Cabeza de Vaca (*1*) visited this region in 1528, he listed a "time when the fish die" in addition to other customary aboriginal appellations for the seasons. Certain Indian tribes along the Pacific forbade their members to eat mussels during red tides or luminescent water, and the sudden extinction of one band may have been caused by this toxin (*10*). It has been suggested that the red tide with its associated phenomena can explain three famous biblical Egyptian plagues when the water turned to blood, followed by an unbearable stench and swarms of flies.

The initial recognition that the local protozoan was a dinoflagellate was made by Ludwik Anigstein. Further observations showed that it was a chain-making, armored form with the sharply broken girdle of the genus *Gonyaulax* (Fig. 3). Its other characteristics indicate it is either *G. catenella* Whedon and Kofoid or a similar new species (*8, 9, 15, 16*). Microscopic examinations have been made of both living and preserved specimens. The illustrations of the latter differ only from the appearance of the living animal in the absence of flagella (Figs. 3, 4). Unfortunately, the preservation of an insufficient number of specimens has prohibited the special technique required for defining the sutures of the cellulose plates of which

the armor is composed. The local species makes longer chains than have been reported for *G. catenella*, but only failure to delineate the sutures has prevented its identification as that species. Actually, this failure implies identity, because indistinct differentiation of the plates is characteristic of *G. catenella* (*16*).

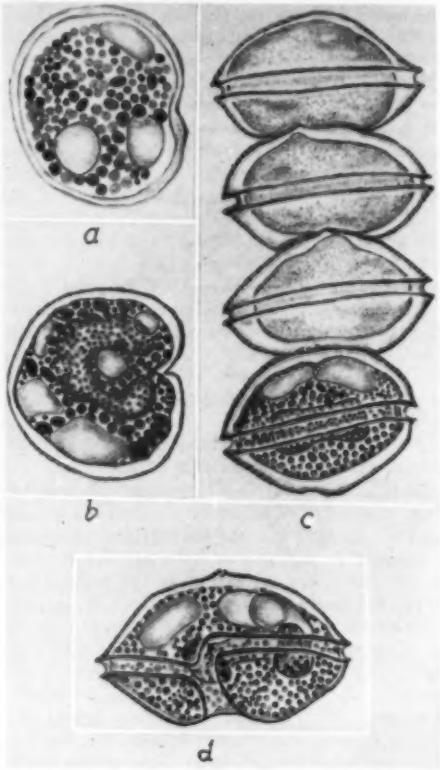

FIG. 3. Camera lucida drawings of local *Gonyaulax*, by J. B. Cross. ×1,300. No flagella, because all illustrations made of specimens preserved in glychrogel; *a*, apical view, apparent double wall is actually girdle; *b*, antapical view, showing nucleus, Giemsa; *c*, dorsal view of short chain; *d*, ventral view showing sulcus and sharp break in girdle.

The two other similar chain-forming *Gonyaulax* can be eliminated readily from consideration. In *G. series* Kofoid and Rigdon (*6*), the central members of a chain are much larger than the terminal members. This is obviously not true of the local species (Fig. 4*a*). In *G. catenata* (Levander), the apical and antapical views have a kidneylike shape, and the nucleus appears as a short, thick club with bulbous ends (*5*). These characteristics are entirely different from the horseshoe-shaped nucleus and almost circular shape of the local species in comparable views (Figs. 3*a*, 3*b*). In these respects, as well as in size, the local species agrees with *G. catenella*, and the shape of the nucleus has been considered by Martin to be more reliable for identification than plate formation (*9*). Measurements on 51 animals from 2 slides gave a median length of 13.5 μ (range, 10.5–17.0, with a giant of 22), a width of 25.2 μ (range, 21.5–30.5), and a transdiameter of 20.7 μ (range, 16.5–24.0). The microphotographs (Fig. 4) show the protozoan filled with vesicles containing a translucent nongranular substance. Such vesicles are found in the peripheral zone of the animal, but the larger central region is packed with the granular bodies of varying sizes that are pictured in the drawings.

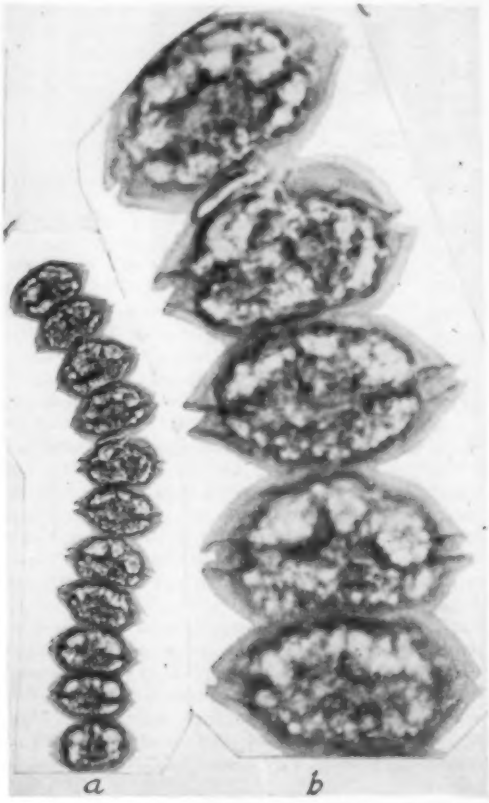

FIG. 4. Microphotographs by F. W. Schmidt. *a*, chain of 11 individuals ×600; *b*, part of *a*, ×1,800, to show detail of armor, girdle, and vesicles.

The virulent poison isolated from *G. catenella* and capable of killing man and other mammals has little effect on fish and does not explain the mass destruction of marine life that has been concurrent with an abundance of these protozoa (*13*).

Gunter attributed the mass mortality of fish in Offatt Bayou, occurring yearly, with one exception, from 1936 through 1941 (*3*), to the stagnation in the inner portions of the bayou plus the accumulation and anaerobic decomposition of organic matter during the summer months. Near-by residents and fishermen have reported the ap-

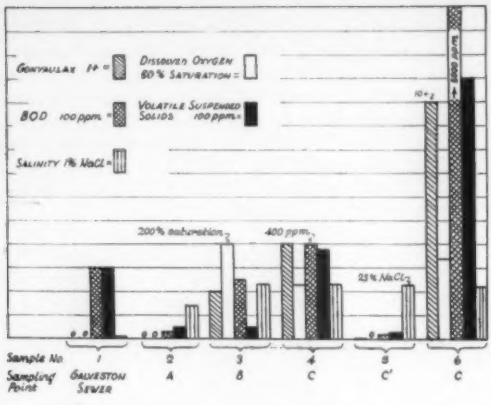

FIG. 5. Results of analyses of representative samples.

pearance of red tides and accompanying phenomena for almost every summer during the past 15–20 years, and that the fish did not die in the "red water" but died quickly when the redness settled and the water became "white" or "milky." The latter terms evidently describe the slightly turbid appearance of the water following submergence of the *Gonyaulax*. Few fish died in the bayou following the initial killing in 1949. Probably the first catastrophe left few survivors to be destroyed later, and fish did not return to the inner areas of the bayou for a week or so after the episode terminated.

The most widespread and destructive period of the 1949 episode started about mid-July, simultaneously with the usual midsummer condition of quiescent water and small tidal variations. Less extensive periods recurred until September 10, after which *Gonyaulax* disappeared during heavy wind and wave action and increased tidal variations.

Observations made following the crest of the episode showed, just as in similar episodes along the Pacific coast, that periods of abundant growth of *Gonyaulax* were invariably accompanied by red water, a distinctive, foul odor, brilliant luminescence, and mortality of fish. Three additional and obviously pertinent associated phenomena, however, were observed and are reported as follows:

1. There were indications that small amounts of sewage pollution favored the growth of the protozoan. The most widespread and destructive visitation followed immediately after heavy rainfalls had flushed sewage-polluted surface water into the bayou from unsewered areas west of the city limits (Fig. 2). Further, those loci at which heavy growths recurred frequently were in wind-sheltered areas of the bayou, where there is light pollution from private septic tanks. Since the effluents from these tanks enter through spoil banks and dredge fillings below mean low tide, it was never possible to detect gross sewage pollution at any of these points. None of Galveston's municipally operated sewers empties into the bayou, but for comparison, sample 1, Fig. 5, shows approximately the composition of the city's sewage. The composition of sewage of maximum strength found flowing into the bayou is represented by sample 2, Fig. 5, which was from a private combined sewer of very small flow. Salinity tests at successive distances from obvious points of entry of sewage demonstrated rapid multiple dilution with the salty bayou water. Even in moderately quiescent water and during periods of slight variations in tidal levels, the salinity 10–20 ft from the points of entry was that of the normal water in the bayou (2.3% NaCl). Coliform organisms were sufficiently numerous, however, to indicate significant sewage pollution of most of the inner areas of the bayou.

2. Extraordinarily wide and rapid variations in the dissolved oxygen content of the water were observed during and immediately following heavy concentrations of *Gonyaulax*. The maximum dissolved oxygen content of 200% saturation was observed in a shallow area with bright sunlight, slight wind and wave action, and widespread growth of *Gonyaulax* (Fig. 5, sample 3). The concentration of the protozoa at this time and place was less than at some other points with lower oxygen content, but practically all the protozoa were living. In samples 4 and 6, there were both living and dead *Gonyaulax*. Fig. 5, sample 4, represents approximately the average composition of samples taken from quiescent areas with heavy growth in sunlight. Late at night the dissolved oxygen content of water containing large numbers of the protozoa ranged from 40 to 90% of saturation.

The most significant observations of variations in dissolved oxygen are evidenced by a comparison of samples 4 and 5. At 8:00 A.M. the concentration of *Gonyaulax* as indicated by the color of the water was the same at points C and C′ (30 ft apart), and the dissolved oxygen was approximately at 100% saturation. By 10:00 A.M. of the same day, the red material (masses of *Gonyaulax*) had submerged deeply at C′ but remained near the surface at C. At 11:00 A.M. the dissolved oxygen at C′ was near zero, and microscopic examination revealed few *Gonyaulax*. At this time, live shrimp placed in the water at C′ died within a few minutes, but live shrimp held in the water for an hour at C showed no ill effects. Similar results were obtained several times. In quiescent areas with a heavy growth of *Gonyaulax*, the dissolved oxygen would remain high, but whenever the mass of organisms rapidly submerged and the water was quiescent, the dissolved oxygen would decrease rapidly. No causes for the submergence were suggested by the present findings.

3. The values of biochemical oxygen demand (BOD) for the samples associated with *Gonyaulax* were extraordinary and far in excess of what might be explained by sewage or any other organic pollutant entering the bayou. That the protozoan contributed heavily to the organic content and the BOD is implied by the fact that the variations in the observed values are roughly proportional to the number of *Gonyaulax*. This is illustrated by the range of values in samples 3 through 6. In sample 6, the BOD was approximately 5,000 ppm, and the water was as intensely discolored by the concentration of the protozoan as though a large amount of ferric hydroxide had been added. It seems logical to assume

that these extraordinarily high values of BOD and consequent anaerobic conditions in the water were attributable to the *Gonyaulax* and were important contributing factors in the mass mortality of fish in Offatt Bayou.

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The Synthesis of L-Ascorbic Acid Uniformly Labeled with C^{14} [1]

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The synthesis of L-ascorbic acids isotopically labeled in different positions is of great interest in biochemical research. Recently Burns and King (*1*) have described a synthesis of 1-C^{14}-L-ascorbic acid.[2] We wish to report the synthesis of uniformly enriched L-ascorbic acid.[2] Our synthesis was patterned after that of Reichstein and Grüssner (*4*) and adapted to working on a semimicro scale.

A mixture of uniformly enriched sucrose, glucose, and fructose was prepared by allowing bean leaves to photosynthesize for 24 hr in an atmosphere of $C^{14}O_2$ (*2*).

The sucrose was hydrolyzed, and a mixture consisting mainly of glucose was precipitated by the addition of absolute ethanol. The mixture, weighing 392 mg and having a specific activity of 1.4 μc/mg, was hydrogenated in an alkaline aqueous medium using Raney nickel. The sorbitol produced was oxidized to sorbose with *Acetobacter suboxydans* by the method of Wells, Stubbs, Lockwood, and Roe (*6*). After the fermentation the organism was removed by centrifuging, and the supernatant liquid was passed through Amberlite IR-100-H and Duolite A-4 ion exchange columns to remove ionic impurities. Crystallization and decolorization with Darco G-60 gave 344 mg of pure sorbose, mp 163°–165° C.

The sorbose was diluted with 135 mg of carrier, and acetonated, using freshly distilled dry acetone, and sulfuric acid as a catalyst. The diacetonesorbose was extracted from unreacted material and monoacetone derivative with ether. Oxidation of the diacetonesorbose with 6% potassium permanganate was carried out in alkaline medium (*3*), the unattacked material from the first oxidation being removed by ether extraction and reoxidized. The two batches were carried through separately to the last step. The reaction mixture was filtered and acidified to pH 2, after which the diacetone-2-ketogulonic acid was extracted with ethyl acetate and refluxed with water for 40 min to effect deacetonation. Lyophilization gave white, powdery 2-ketogulonic acid, mp 170°–171° C. The methyl ester was prepared by passing a large excess of diazomethane into a methanolic solution of the acid at −15° C. By crystallization from methanol-acetone, 68 mg of white crystals, mp 145°–150° C, was obtained. There was obtained in addition 220 mg of residual oil, consisting partly of methyl 2-ketogulonate, which could not be induced to crystallize and was therefore diluted with 205 mg of carrier and carried through the last step. Treatment under nitrogen of the methanolic solutions of the ester with stoichiometric amounts of 4.65*N* sodium methoxide in methanol and 2.60*N* hydrogen chloride in methanol, gave, after purification according to the method of Szent-Györgyi (*5*), 30 mg of L-ascorbic acid having specific activity of 0.80 μc/mg, and 70 mg having specific activity 0.16 μc/mg. The products melted at 189°–190° C, and gave a single spot of proper R_f value on a paper chromatogram.

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[1] Research carried out under the auspices of the Atomic Energy Commission.

[2] According to suggestions for the naming of isotopically labeled compounds proposed at the Chemistry Conference, Brookhaven National Laboratory, and shortly to be published, these acids would be known as L-ascorbic acid-1-C^{14}, and L-ascorbic acid-ue-C^{14}, respectively.

Comments and Communications

Statement on Atomic Energy Commission Fellowship

From January, 1947, to September, 1948, I was employed at the Oak Ridge National Laboratory by contractors of the Atomic Energy Commission. For this work I was cleared by the FBI and had admittance to the Restricted Area.

In September, 1948, I was awarded an Atomic Energy Commission Predoctoral Fellowship in the Biological Sciences, which I have held until the present time. The fellowship carried no loyalty or security regulations for students doing nonsecret work, and it was not stated that the purpose of such fellowships was to train students to work for the AEC.

In August, 1949, in a rider to the 1950 Independent Offices Appropriations Act, Congress passed a provision that requires loyalty investigations of all persons awarded AEC fellowships, including those doing nonsecret work. The purpose of such legislation in this extended form can no longer be interpreted as the protection of secrets of military importance to the nation, but rather as political motivation in the choice of individuals to receive support.

Because of the implications that such legislation holds for the future of scientists in this country, I feel it necessary to resign from my fellowship and to express publicly what I think are the dangers involved.

The practical results of science are obvious to everyone living in our civilization, and it is frequently assumed that the production of an improved technology is the sole aim of science. The more fundamental aspect of science —as a continuous creative effort through which man attempts to increase his understanding of himself and the universe in which he lives—is less often appreciated. Yet this aspect is the one from which the knowledge necessary for the more obvious technological developments is derived, and the level at which the real advances in our understanding are made. If science is to continue to be an important phase of human activity, then we must maintain an atmosphere in which fundamental research in all fields can continue to develop.

The nature of science is such that the sole criterion for judging the success of scientific efforts lies in the truthfulness of the formulations developed. The methods of testing the validity of these theories are continually being refined, and the scope of the observed facts that the theories must explain is continually increasing, making greater demands upon the abilities of the investigator and the comprehensiveness of his concepts.

Thus the individual scientist must weigh his theories impartially and must continually and rigorously discard those he finds to be inadequate. This requires that he be free from external pressure in his decisions. The frustrating effects of the imposition of criteria other than the one of truthfulness upon the findings of scientists have been tragically apparent to the world in recent years.

It becomes obvious that, since the success of scientific achievement lies in its truthfulness, the method automatically eliminates from the ranks of scientists any investigator who would deliberately falsify his results. The political beliefs that a scientist holds may be affected by his scientific understanding, but his scientific interpretations cannot be influenced by these beliefs or he is no longer acting as a scientist. The results of his work must be incorporated into the total body of scientific knowledge and must harmonize with this knowledge, or it is recognized that something is wrong. Further investigation will then reveal either that the earlier knowledge was incomplete and must be modified in interpretation, or that the later investigator was wrong in fact or in interpretation. Thus it is important to realize that the nature of the method operates as a control on those using it.

Since it is essential that the individual scientist be free from outside influence, and since the scientific method itself serves to maintain the professional integrity of the investigator, I think that a law barring from support for scientific training or research persons with particular political views can serve no purpose favorable to the advancement of science. The basis for the application of the law to scientists does not lie in any inherent danger that the scientific method may be successfully distorted to serve ideological purposes. Thus there is no reason to believe that the individuals who feel such legislation is necessary for scientists will not feel the need to extend it to other phases of activity.

This law indicates that the government is willing to aid only those individuals whose social views correspond to beliefs approved by the agencies conducting the government investigations of loyalty or by those passing on the information thus obtained. A narrow interpretation of this or similar legislation in the hands of uninformed individuals could very easily lead to a situation intolerable to scientific research.

The implications of an extension of such legislation throughout our society are far-reaching and frightening. To institute a criterion of political orthodoxy to sanction the position of individuals in all fields of thought and action could only lead, eventually, to the elimination of the most imaginative intellects in society. In this event, a steady progressive evolution of our society, based upon increased understanding of the nature of man and of the universe, would become impossible.

Since the legislation under question is so well defined and is without precedent in this country, I believe the issue can be fought clearly at this point, and that the time to oppose the possibility of political control of scientific research is at this opening movement. Govern-

ment support of scientific research will become increasingly necessary and important in the future, and the manner in which this support is administered will become increasingly significant.

The firm stand taken by the National Academy of Sciences and groups like the Federation of American Scientists is, in my opinion, excellent. But, unless their position is supported by individual action, I believe it will lose significance. Therefore, I wish this resignation to be recorded as the protest of one student against a ruling that I believe to be directed against the freedom of the individual scientist and the interest of our society as a whole.

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Nomenclature of the Rh-CDE System

In a recent paper by E. F. Ducey and R. I. Modica on the amendment of the nomenclature of the Rh-CDE System (*Science*, 1950, **111**, 466) several errors are to be noted in the use of the Wiener Rh-Hr nomenclature:

1. Table 1 indicates the following under Wiener's antigens: Rh_o, rh′, rh″, Hr_o, rh′, and rh″. The last two antigens should correctly read hr′ and hr″. Likewise, under Wiener's agglutinins, the last three indicated as Anti-Rh_o, Anti-rh′, and Anti-rh″ should correctly read Anti-Hr_o, Anti-hr′, and Anti-hr″.

2. In the sentence "For example, Wiener must use a different set of terms for the genotypes and the phenotypes (Rh_1, Rh_o and R_1, R_o, etc.)," the order of "genotypes and phenotypes" implies a respective arrangement in the symbols appearing in the parentheses, "(Rh_1, Rh_o and R_1, R_o, etc.)." Concerning the latter, it is to be noted that symbols Rh_1 and Rh_o represent phenotypes and not, as implied, genotypes; also, contrary to the implication, symbols R_1 and R_o represent neither phenotypes nor genotypes. According to the Wiener nomenclature, a genotype consists of two italicized symbols (a symbol for the gene contributed by each parent). Therefore, the possible genotypes falling under phenotypes Rh_1 and Rh_o would correctly be R^1R^1, R^1r', R^1R^2, R^1r, R^2r', and R^2R^2, R^2r, respectively.

3. It is further stated that the Wiener symbol Rh_1 does not indicate whether the individual is homozygous or heterozygous, and that the corresponding Race symbol CDe/CDe or CDe/cde does. In this case a comparison has been made between a phenotypic symbol (Rh_1) and a genotypic symbol (CDe/CDe or CDe/cde). A valid comparison would have been made had genotypic symbols representing both systems of nomenclature been used, e.g., CDe/CDe = R^1R^1 and CDe/cde = R^1r.

4. For the sake of comparing Wiener's symbols against those of Race, the possible progeny resulting from the mating of an Rh_1 individual with an rh individual is discussed. Here again there exists a situation similar to that mentioned in (3); i.e., Wiener's phenotypes are compared with Race's genotypes. Also, it is stated that in the above-mentioned mating the possible progeny are Rh′, Rh_1, Rh_o, and rh″. The Rh′ is incorrect and should read rh′.

Employing several symbols mentioned above, the following table may serve to depict a more complete comparison between the Wiener and Race nomenclatures.

Phenotypes		Genotypes	
Wiener	Race	Wiener	Race
rh	cde	rr	cde/cde
Rh_1	CDe	R^1R^1	CDe/CDe
		R^1r'	CDe/Cde
		R^1R^2	CDe/cDe
		R^1r	CDe/cde
		R^2r'	cDe/Cde

ALBERT EINHEBER

Handbook of Biological Data
American Institute of Biological Sciences
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Ducey and Modica actually recommend the abandonment of the Wiener nomenclature and a modification of the Fisher-Race terminology. The gist of the latter is the substitution of D′, C′, and E′ for d, c, and e, because "the use of the lower case letters c, d, and e, to denote the Hr antigens leads to ambiguity when it is remembered that in the major groups, a and b indicate agglutinins." Therefore, the lower-case letters are to be reserved for agglutinins, the capital letters for antigens. The agglutinins are to be labeled anti-d, anti-c, anti-e, anti-d′, anti-c′, and anti-e′.

I do not wish to enter the controversy on the respective merits of the two main systems of Rh nomenclature, but would like to call attention to one major defect in the recommendation of Ducey and Modica. It is true that a and b denote agglutinins in the ABO blood group system, but many objections have been raised against their use, because it is misleading. The modern tendency followed in most textbooks and scientific papers is to use anti-A and anti-B instead of a and b, as the only clear designations of these two isoagglutinins. Therefore, to be consistent, Ducey and Modica's recommendation for the agglutinins would have to label them as anti-D, anti-C, etc. Otherwise the proposed amendment would, I am afraid, only add to the confusion.

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The recent criticism of current *Rh* terminology by Ducey and Modica correctly points out the comparative simplicity of teaching and understanding the Fisher-Race scheme but misses a far more significant fact, i.e., the possibility that Wiener's hypothesis of a series of multiple alleles at one locus on homologous chromosomes may be correct. The only method apparent at present of coming to any decision concerning relative correctness of

either theory has been succinctly discussed in the "Report of the Advisory Review Board" (*Science*, 1948, **107**, 27).

As far as terminology is concerned, it should be borne in mind that every aspect of the Fisher-Race scheme is duplicated in the Wiener scheme (a fact emphasized in the Report of the Advisory Review Board).

The criticisms, therefore, that a different set of terms must be used in the Wiener scheme for phenotypes and genotypes, or that any symbol does not indicate homozygosity or heterozygosity, etc., are unjustified. The Report of the Advisory Review Board has modified and incorporated Wiener's suggestion for distinguishing between genes and erythrocyte agglutinogen factors by printing gene designations in italics and antigen designations in ordinary type.

When one designates the phenotype Rh_0 (Wiener), what is now implied is the phenotypic constitution Rh_0 hr′ hr″. It is perhaps redundant to point out that, if this were not so, then it would be a simple matter to distinguish the relative correctness of either theory; e.g., available anti-e (hr′) serum either would or would not react with 100% of the Rh negative population.

Insofar as the proposed amendment of the nomenclature by Ducey and Modica is concerned, certain facts make it extremely undesirable (aside from the reeducation of physicians, experimental workers, editors, and proofreaders). The use of superscript distinctions can only result in a newer variety of the old confusion. The suggested use of designations other than the small letters c, d, and e to denote Hr antigens is based on a fallacy. The letters a and b do not indicate agglutinins. Major blood group agglutinins, by older terminology, are referred to as *alpha* and *beta*. This is the justification for the current trend to use the terms Anti-A and Anti-B to designate beta and alpha agglutinins, respectively. To substitute the letters a and b at any point in the major blood groups nomenclature immediately confuses that terminology. The proposal that small letters be reserved for agglutinins and capital letters for antigens adds nothing to the present situation. The Fisher-Race scheme is as adaptable to the discovery and naming of new genes, antigens, and agglutinins as is the proposed system.

The Review Board's statement that the Fisher-Race theory (and nomenclature) "is based on a genetic hypothesis, which is purely theoretical and for which no clear proof exists—a hypothesis no more tenable on genetic grounds than Wiener's hypothesis" is, in our opinion, a clear exposition of the current situation, and the recommendation that both systems of nomenclature be used concurrently, although not the most desirable, is the only scientifically honest recommendation possible at this time.

There would seem to be little doubt that, if the two hypotheses and systems of nomenclature continue to explain newer observations, the Wiener scheme will eventually disappear because of its own relative unwieldiness.

The Utah State Health Department is currently using the Fisher-Race nomenclature exclusively, although it recognizes the possibility that the scheme is based on incorrect theory. Practically, however, it has been found far easier to use this scheme than the Wiener scheme to explain to practicing physicians the rarely occurring, more esoteric aspects of isosensitization due to Rh factors.

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Developments in Oceanography

Judging from manuscripts which we have on file, the communication "Education and Training for Oceanographers," which was published in SCIENCE June 23, 1950, was written prior to January, 1949. Since that time there have been extensive developments in oceanography at the A. and M. College of Texas, where a Department of Oceanography has been established in the School of Arts and Sciences. These developments may be of interest to your readers.

Instead of our courses in oceanography being offered as "part of various curricula," they actually make up a graduate curriculum in oceanography, which leads to the Master of Science degree in that field. It is expected that this program will be augmented so as to permit work at the doctoral level in the near future.

We are now engaged in several oceanographic research projects—one a systematic investigation of the oceanography and meteorology of the Gulf of Mexico sponsored by the Office of Naval Research; another a project in biological oceanography conducted at the laboratory of the Texas A. and M. Research Foundation at Grand Isle, Louisiana, and sponsored by a group of the major oil companies operating on the Gulf Coast; another a cooperative program with the Fisheries Biology Section of the U. S. Fish and Wildlife Service conducted from the oceanographic vessel, the *Alaska*; and a fourth, the work done under the Dow Research Fellowship in Chemical Oceanography. Other work is pending.

The initial academic staff includes, in addition to the writer, who is professor of physical oceanography and marine meteorology, W. Armstrong Price, professor of geological oceanography, John G. Mackin, professor of biological oceanography, and Donald W. Hood, assistant professor of chemical oceanography. Another staff member is to be added in physical oceanography and marine meteorology in February, 1951.

The A. and M. graduate program in oceanography is strengthened by close association with the Departments of Biology, Chemistry, Geology, Physics, Mathematics, Geography, and the School of Engineering. Research is conducted through the Texas A. and M. Research Foundation, which is legally and financially independent of the college but is dedicated to its welfare and has available to it the staff and facilities of the college.

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Chelating Agents and Urinary Calculi

Preliminary experiments with chelating agents such as ethylenediamine tetraacetic acid (Sequestrene, generously supplied by the Alrose Chemical Co., Providence, R. I.) and allied substances indicate a definite applicability to clinical problems. These compounds form strong unionized complexes with calcium, barium, strontium, zinc, lead, and other divalent ions, as well as some of the trivalent metallic ions. Each Sequestrene molecule bonds a molecule of the metal so that the product is quantitatively more effective against the heavier metals than the lighter. This differential affinity may be useful clinically.

Experiments *in vitro* have been run comparing the solubility of various urinary calcium calculi in a 3% solution of Sequestrene (pH 7.0) with that in Suby's solution G (pH 4.0), at present the most effective of the available clinical solvents. Sequestrene was found to be consistently much more effective with all types of stones used (calcium oxalate, calcium phosphate, and calcium carbonate). It has the additional advantage of a maximum efficiency at a neutral pH compared to the acid pH of Suby's solution. When used to irrigate the bladder, however, it was found to be fairly irritating. Whether this is due to the removal of the calcium ion or to impurities in the product, is still to be determined.

Other studies have been made using Sequestrene injected intravenously in rabbits as a treatment for acute lead poisoning. Theoretically, the heavier lead ion should be sequestered more effectively than the calcium so that subtetanic doses can be used. The early results appear promising.

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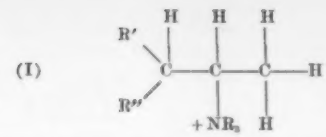
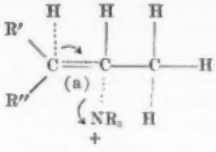
Steric Effects in Bimolecular Eliminations

In a recent series of articles (*J. Chem. Soc.*, 1949, 2093), Hughes, Ingold, *et al.* have discussed bimolecular elimination reactions. Whereas attempts are made to explain the reasons for different products obtained in eliminations governed by Hoffman and Saytzeff rules, the reasons offered seem to be mere restatements of conditions necessary for the occurrence of the respective eliminations.

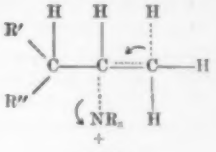
An explanation for the apparent anomality existing in eliminations that proceed by the Hoffman and Saytzeff rules may be based upon steric considerations (Schramm, Harvard University Seminar, Spring, 1949). In the case of elimination from quaternary salts (I), where R′ = alkyl, R″ = alkyl or H,



the transition state may be a priori either (II) or (III):

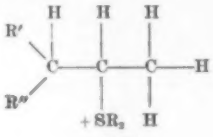


(II)



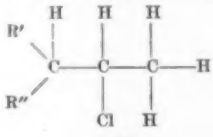
(III)

The transition state of (II) with electronic shifts as indicated would require groups R′, R″, and +NR₃ to lie in one plane by virtue of the partial double bond character of the bond at (*a*). This would introduce a strong steric effect into the reaction, and elimination in the direction as indicated in (III) would be favored. Analogous reasoning would be applicable to the corresponding sulfonium salt (IV).



(IV)

When one considers the alkyl halide (V),



(V)

such steric limitations would, for the most part, be precluded. It may well be that the Saytzeff rule is the general rule that governs bimolecular eliminations, whereas the Hoffman rule is the exception, applying in cases where steric effects, such as outlined above, are involved.

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Book Reviews

Volcanological Observations. Frank Alvord Perret. Washington, D. C.: Carnegie Institution of Washington, 1950. 162 pp. $5.00 paper; $5.50 cloth.

Frank Alvord Perret's last publication is obligatory reading for anyone wishing to learn about volcanoes and volcanism. It amounts to a textbook on the many aspects of volcanism, though written in a readable style and recounting mainly personal observations. Perret's experience with volcanoes was very wide. Though largely self-educated in the field of geology (he was an electrical engineer before he shifted his affections), no other American has visited so many active volcanoes and made observations during their periods of violence.

The Carnegie Institution has done a great service to students of volcanology by publishing this volume of Frank Perret's memoirs and observations. These are arranged according to the different aspects of eruptions, with, first, descriptions of the volcanoes themselves and their various types; next, various types of lava and their variations in behavior. The gases, the electrical phenomena, the bombs, and the ashes all are discussed and documented from Perret's personal experiences. His equipment, primitive in many respects but nevertheless practical, is described and will suggest modifications and improvements to today's observers. The final chapter sums up the value of such work in relation to man and discusses the possibility of predicting eruptions and of discounting the apparent danger of abortive activity.

Although the author claims that the work is largely one of observation, with little place for theories and hypotheses, we find on careful reading that it is filled with suggestions that may help to explain volcanic mechanisms. Some of them, such as the rhythmical uplift of the lava with periodic compressional heating of the trapped gas, seem very reasonable; far more reasonable than an idea that the lava of the old Kilauea lake was made even hotter by oxidation reactions at the surface. All through the work we find many ideas that Perret's successors might well investigate. He remarks somewhere that each volcano and each eruption are unique, that what one observer may see on a given spot is not necessarily what another observer will see at the same place a few days later.

Nevertheless, there is a remarkable continuity and likeness among eruptions. Parícutin has shown, at one time or another, nearly all the phenomena described as typical of volcanoes studied by Perret throughout the world for forty years. With one observation we must take issue—one who has seen the skyrocket bursts from Parícutin, spearheaded by great bombs that eventually fall out trailing clouds of dust, could not agree with Perret's suggestion that volcanic bombs are dragged out by the upward suck of the rising gas and dust explosions. In the case of Parícutin there seems little doubt that they are projectiles. It is a pity that Perret's death only a month before the birth of Parícutin prevented his studying that eruption too.

One must agree with Leason H. Adams, of the Geophysical Laboratory, that this publication of the Carnegie Institution will stand with Perret's earlier ones "as an enduring monument to a great volcanologist." It is filled with personal observations and anecdotes that reveal much about the writer. It is a beautiful job of writing and assembling and it is a thoroughly worthwhile publication, the reading of which will well repay the student and the interested layman.

FREDERICK H. POUGH
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Steroid Hormones and Tumors: Tumorigenic and Antitumorigenic Actions of Steroid Hormones and the Steroid Homeostasis. Alexander Lipschutz. Baltimore, Md.: Williams & Wilkins, 1950. 309 pp. $6.00.

This volume is primarily a résumé of the investigative work reported by the author and his associates in widely distributed journals (Chilean, American, British, French, and Canadian), and secondarily a review of related work undertaken in other laboratories throughout the world. Most of the illustrations are microphotographs or photographs of materials from experiments in which guinea pigs were used.

The influence of different estrogenic chemicals, in difference doses, and applied by different methods, on the formation of fibroblastic or myofibroblastic proliferations of the abdominal serosa and subserosus tissues is well illustrated and discussed in detail. Quantitative aspects are not presented in tabular form, but reference is made to the original publications. The antifibromatogenic action of steroids with progestational, androgenic, or adrenal cortical activity is presented. The "fibrous reaction" occurs specifically in guinea pigs given estrogenic chemicals and is reversible subsequent to discontinuance of treatment or the administration of adequate amounts of antifibromatogenic chemicals. The greater part of the work thus deals with hyperplastic or proliferative rather than malignant responses.

In addition to the fibrous reaction or fibromatogenic response, hyperplastic and metaplastic changes in other tissues and organs of estrogen-treated guinea pigs are described in detail.

Several experiments are described in which the hormonal balances (hormonal homeostasis) have been modified in guinea pigs by partial ablation of the gonads or by gonadal transplantation. Dr. Lipschutz' many years of experience in experimental endocrinology add interest to the interpretation of the data.

Researches undertaken on other animals are extensively reviewed incidental to the presentation of the investiga-

tions undertaken on guinea pigs. The literature is reviewed as adequately as in any recent review, except for the clinical studies, and the bibliography probably contains a more extensive citation of papers (40 pp.) reporting abnormal hyperplastic and metaplastic responses.

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Histology. Arthur Worth Ham. Philadelphia: Lippincott, 1950. 756 pp. $10.00.

This newcomer to the field of books on histology represents a carefully executed attempt to combine essential histological facts with various pedagogical devices in order to assist the student in learning and comprehending the subject matter.

Much space is given to introductory remarks, whereby the student becomes acquainted with the field of histology and with its relation to the closely allied sciences of physiology, biochemistry, and pathology. The materials, methods, and tools of the student of histology, are discussed, and the student is instructed in interpreting microscopic images and in evaluating artifacts in histological preparations.

In the body of the book the manner of presentation differs somewhat from the usual one. Emphasis has been placed on topics of special interest at the present time. The nature and integrity of tissues and their components, cells and intercellular substances, are admirably treated and reflect the widespread interest in the cancer problem. A chapter on tissue fluid and its role in body function is of marked value. Current interest in the cardiovascular system is reflected in the author's generous consideration of blood vessels and the clotting of blood.

The interest of the medical student is continually stimulated by the addition of obvious applications of the subject under description to its later use and need by the practitioner of medicine. This is especially well done in the sections on skin and the circulatory system.

The 445 illustrations are well conceived. No doubt in later editions more of the described structures will be illustrated, as, for example, the degeneration and regeneration of peripheral nerve fibers. Human material has been employed in a good percentage of the figures. A consistent method of labeling, in size and character of type, and a more generous use of colored illustrations would have improved this important portion.

The teacher must bear in mind when reading this book that it is written primarily for the student. With an easy, informal, conversational—at times "popularized" —approach the author has attempted to lead the student through an orderly progression of histological facts, pausing now and then to develop concepts, to draw helpful comparisons, to indicate functional significance, and to stimulate the curiosity. The book seems oversimplified, although many students find their way better through such simplification. One feels that, in places, the book contains unnecessarily lengthy physiological and speculative considerations. It is regrettable that such a procedure has required the omission of pertinent histological details in order to avoid a volume of too much bulk.

Professor Ham has succeeded in his attempt to make this a unique and thoroughly new book. The convictions that motivated this new approach are commendable.

A. J. RAMSAY

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Jefferson Medical College

Nuclear Physics: A Textbook. Francis Bitter. Cambridge, Mass.: Addison-Wesley, 1950. 200 pp. $5.50.

This text of some 200 pages has been written, in the author's words,

> . . . for students who have had a course in atomic theory in addition to the usual introductory physics courses. Since it is often impossible to give separate instruction to students intending to continue the study of nuclear science and to those intending to specialize in some other field, an attempt has been made to write a book suitable for both groups.

The "attempt," in the opinion of the reviewers, has been successful. The presentation is direct and simple and shows an understanding of the problems met by students of a first course in nuclear physics. Although the book will serve to stimulate rather than satisfy the student's interest in the topics discussed, it should give those in other fields a reasonably complete and accurate picture of the present status of nuclear physics.

One of the most attractive features of the book is the large number of lucid diagrams. The time and effort that have clearly been spent in their preparation and in the selection of exercises at the end of each chapter should add greatly to the ease of assimilating the material.

The presentation starts out with an inspiring chapter on the evolution of nuclear physics. It emphasizes the fluid state of the subject—an attractive aspect in the eyes of the young. Subsequent sections briefly treat such topics as the mass defect curve, collision theory, properties of nuclei (radii, spins, magnetic moments), radioactivity, and nuclear reactions in a very clear manner. The general viewpoint is that of an experimental physicist, and the more deeply speculative and troublesome parts of the theory are subdued.

The last two chapters are largely concerned with chain reactions and the consequences of fission, such as administrative questions for nuclear power, health considerations, and the control of atomic energy. Although these problems are admittedly of primary concern, it is felt that their purpose would be better served in other than a physics textbook.

This text should adequately fulfill its purpose, and it is recommended that those teaching an introductory or descriptive course in nuclear physics give it serious consideration.

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Sloane Physics Laboratory
Yale University

Scientific Book Register

Botany: An Evolutionary Approach. R. Darnley Gibbs. Philadelphia: Blakiston, 1950. 554 pp. $6.00.

The Science of Petroleum: Crude Oils, Chemical and Physical Properties, Vol. V, Part I. Benjamin T. Brooks and A. E. Dunstan, Eds. New York: Oxford Univ. Press, 1950. 200 pp. $11.00.

Cycles in Weather and Solar Activity. Maxwell O. Johnson. Honolulu, Hawaii; Paradise of the Pacific Press, 1950. 224 pp. $5.00.

The Chordates. Herbert W. Rand. Philadelphia: Blakiston, 1950. 862 pp. $6.00.

Chemical Thermodynamics. Frederick D. Rossini. New York: Wiley; London: Chapman & Hall, 1950. 514 pp. $6.00.

The Clinical Use of Radioactive Isotopes. Bertram V. A. Low-Beer. Springfield, Ill.: Charles C. Thomas, 1950. 414 pp. $9.50.

Biology of Drosophila. M. Demerec, Ed. New York: Wiley; London: Chapman & Hall, 1950. 632 pp. $10.00.

Surgery of Cataract. Daniel B. Kirby. Philadelphia: Lippincott, 1950. 695 pp. $30.00.

Projective Psychology: Clinical Approaches to the Total Personality. Lawrence Edwin Abt and Leopold Bellak, Eds. New York: Knopf, 1950. 485 pp. $6.00.

The Biochemistry of B Vitamins. Roger J. Williams *et al.* New York: Reinhold, 1950. 741 pp. $10.00.

Mid-Century: The Social Implications of Scientific Progress. Mid-Century Convocation of the Massachusetts Institute of Technology. John Ely Burchard, Ed. Cambridge, Mass.; Technology Press; New York: Wiley, 1950. 549 pp. $7.50.

Metals at High Temperatures. Frances Hurd Clark. New York: Reinhold, 1950. 372 pp. $7.00.

Pneumoconiosis: Beryllium, Bauxite Fumes, Compensation. Leroy U. Gardner Memorial Volume. Arthur J. Vorwald, Ed. New York: Hoeber, 1950. 659 pp. $7.50.

A Manual of Organic Chemistry for Advanced Students: The Compounds of Carbon, Hydrogen, Oxygen and the Halogens, Vol. 1. G. Malcolm Dyson. London-New York: Longmans, Green, 1950. 984 pp. $12.50.

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Photography in Astronomy. E. W. H. Selwyn. Rochester, N. Y.: Eastman Kodak Company, 1950. 112 pp. $2.75.

The Rhesus Danger: Its Medical, Moral and Legal Aspects. R. N. C. McCurdy. London, Engl.: William Heinemann, 1950. 138 pp. 5/– net.

Studies in Bird Migration: Being the Collected Papers of H. Chr. C. Mortensen. Poul Jespersen and A. Vedel Tåning, Eds. Copenhagen, Denmark: Ejnar Munksgaard, 1950. 272 pp. Dan. kr. 18.

An Introduction to the Embryology of Angiosperms. P. Maheshwari. New York: McGraw-Hill, 1950. 453 pp. $6.00.

Eyes and Industry. 2nd ed. of "Industrial Ophthalmology." Hedwig S. Kuhn. St. Louis, Mo.: Mosby, 1950. 378 pp. $8.50.

Colloid Chemistry, Vol. VII. Jerome Alexander, Ed. New York: Reinhold, 1950. 736 pp. $15.00.

A Monograph of the Existing Crinoids: The Comatulids, Vol. 1—***Superfamily Tropiometrida,*** Part 4c. U. S. National Museum, Bulletin 82. Austin Hobart Clark. Washington, D. C.: U. S. Government Printing Office, 1950. 383 pp., 32 plates. $2.25.

Linton's Animal Nutrition and Veterinary Dietetics. 3rd ed. John T. Abrams. Edinburgh, Scotland: W. Green & Son, 1950. 521 pp. 42/–.

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News and Notes

The Residues of Malnutrition and Starvation

Ancel Keys

Laboratory of Physiological Hygiene, University of Minnesota, Minneapolis

On June 1 and 2, 1950, specialists on nutritional, medical, and agricultural science assembled at the University of Minnesota Laboratory of Physiological Hygiene in a Conference on the Residues of Nutritional Insult. Attention was focused on the effects in man of periods of food shortage, semistarvation, and severe malnutrition, particularly as encountered in war and in natural catastrophe. As a result of the discussions and of consideration of the scientific evidence, it was decided to set forth the major items of agreement among the members of the conference. It was further agreed that, because of the importance and urgency of the questions involved, these points of agreement should be brought to the attention of various agencies and organizations which have, or should have, responsibility and concern in regard to these matters. The resulting statement represents the opinions of the members of the conference as individuals and not necessarily those of the organizations with which they are affiliated. Several persons who were unable to attend the conference but whose knowledge and experience give weight to their opinions on these questions were invited to examine this statement. Their agreement with it is signified by the addition of their names to those of the members subjoined to this statement.

There was agreement on the following points:

1. Even in times of comparative peace and prosperity man suffers from malnutrition, including semistarvation or actual starvation, as a result of disease, injury, individual poverty, nutritional ignorance, inequitable food distribution, and crop failure. These factors are aggravated in many parts of the world by population pressures that tend to exceed the food production.

2. Periods of war, great civil disorder, and economic or natural catastrophe are generally attended by food shortages, disruption of normal distribution of food, or outright famine. The resulting human suffering and injury often far exceed that from the physical violence of these periods.

3. The more immediate results in man of malnutrition are only partly known. Knowledge is particularly deficient on the important effects on work performance and capacity, on the response to concomitant disease or trauma, and on psychological characteristics.

4. Knowledge of the residues in man, that is, later or more persistent effects that are attributable to periods of severe malnutrition, is extremely deficient, in spite of the fact that such knowledge is of the greatest importance in planning for national emergencies, in devising therapeutic and rehabilitation measures, in operating compensation and insurance programs, and in general medical practice.

5. Residues from severe or protracted nutritional injury and other stresses sustained in prison and concentration camps and in famine areas during the last world war have been described by various observers. These aftereffects may be apparent for many months or years in formerly healthy men. Among the reported residues are excessive fatigue, weakness, inability to maintain proper weight, general "nervousness," excessive sweating, paresthesias, visual defects including optic atrophy, hernias developed during the period of emaciation, cardiac and gastrointestinal complaints, and bone defects. Many persons apparently recover completely from episodes of malnutrition, but in some cases, at least, there are residues that may result in serious impairment, or even total loss, of the ability to maintain gainful employment.

6. Periods of famine or malnutrition inevitably raise the question of nutritional relief and rehabilitation of the victims. Knowledge for these purposes of the best kinds and amounts of foods and their most efficient distribution and administration is extremely deficient.

7. There are important practical and theoretical questions in regard to the influence of age and sex on the occurrence and nature of residues from malnutrition and starvation. Differences in the mortality during famine have been observed repeatedly, but the possible influence of age and sex on the residual effects in survivors has not been studied. Among the major problems that relate to age and sex are possible differences in the ability to withstand starvation, the effects of maternal malnutrition on the fetus, and the speed and completeness with which rehabilitation may be achieved on a good diet.

8. The rate of growth of children is, under suitable conditions, a sensitive index to changes in the food supply and dietary practice in a nation.

Other suggested indexes, in which more allowance must be made for the operation of factors other than nutrition, include the morbidity and mortality from tuberculosis and the gross mortality of infants below the age of one year.

9. Malnutrition in children frequently results in retarded growth, particularly in terms of body weight but also in linear dimensions. Where the nutritional insult is primarily simple reduction in food intake, and this is not continued beyond a year or two, the available evidence indicates that restoration of adequate feeding results in rapid resumption of growth, so that the eventual body dimensions may not be inferior to the expectation in the absence of a period of undernutrition. Malnutrition that involves deficiencies of vitamin A or vitamin D readily results in serious permanent residues. Much less is known about possible residues in children from deficiencies of other essential nutrients or from caloric deficiency extending over a period of more than one or two years.

10. Occidentals subjected to food deprivation in the Orient tend to exhibit more serious residues than result from similar conditions of food deprivation in Western Europe. This difference may be explained, in part, as a result of the habitual diet and in the local foodstuffs used in the Orient. The foods commonly used in Western Europe in famine or periods of food shortage tend to be qualitatively superior to those eaten in comparable periods in the Orient. The question of residues of famine and malnutrition in the indigenous population in the Orient has been inadequately studied.

11. Among residues of malnutrition must be counted possible secondary effects resulting from changes in the susceptibility to, or in the course of, other disease. With the exception of tuberculosis and diabetes melitus, there is at present very little knowledge on these questions. Simple undernutrition tends to have a favorable effect in diabetes and a very detrimental effect in tuberculosis. In addition, malnutrition may influence the susceptibility to, or the course of, such important diseases as arteriosclerosis, hypertension, neoplasms, allergic states, cirrhosis of the liver, peptic ulcer, the arthritides, and certain of the anemias.

12. The problem of psychological residues of malnutrition and starvation is of great importance but has received very little study. Perhaps even more than in the case of physical residues, psychological residues are conditioned, at least in part, by the attending circumstances under which the nutritional insult is sustained. In many cases of severe malnutrition it is believed the psychological residues are large and important.

13. The conferees wish to commend the Articles which refer to food and nutrition in the Geneva Convention of August 12, 1949, "Relative to the Protection of Civilian Persons in Time of War." It should be pointed out, however, that the absence of definitions for nutritional "adequacy," for "good health," and for the evaluation of nutritional status will make for great difficulty in any application of the Convention. The implementation of such an instrument requires the use of properly defined concepts based on scientific research.

With the foregoing points in mind, and in consideration of other information, the following recommendations are made:

1. The conferees urge in the strongest terms the adoption of all effective and available measures of research, of planning, of organization, of law, and of convention, at both national and international levels, which will serve to prevent or reduce the frequency and severity of malnutrition and starvation. This is of the greatest importance for the contingency of war or other catastrophe.

2. Although the science of human nutrition contains many as yet undeveloped areas, there is already a large body of knowledge that should be fully used to prevent, to ameliorate, to evaluate, and to treat malnutrition. Decisions and planning that relate to, or that may involve, nutritional problems should in every case be based on scientific analysis. It is recommended, therefore, that properly qualified experts on human nutrition, and on related subjects of public health, agriculture, food technology, distribution, and transportation be included in, or attached to, all bodies charged with planning for eventualities in which nutritional problems may arise.

3. The effects, including residues, of periods of malnutrition have tremendous sociological and political implications beyond the limitations of ordinary medical practice. The conferees have indicated above some of the present deficiencies in our knowledge on these problems. It is clearly imperative to make strenuous efforts to increase our knowledge as rapidly as possible. It is recommended, therefore, that facilities and support for nutritional research be greatly expanded, particularly on those problems of human malnutrition that threaten large segments of the world's population in war and in other great catastrophes.

4. Canadian experience with former prisoners of war suggests that detailed scrutiny of persons who have suffered severe malnutrition in the past may yield definitive information with regard to more or less permanent residues. Of great importance in this connection are permanent visual defects and other signs of disordered neurological function. It is recommended, therefore, that systematic studies

be made on the incidence and character of neurological and other defects that may be attributable to previous malnutrition in former prisoners of war and in former inmates of civilian concentration and internment camps. The support of such studies in the U. S. would be particularly appropriate activities for such agencies as the offices of the Surgeons General of the Armed Services and of the Public Health Service, of the War Claims Commission, and of the Bureau of Veterans' Affairs.

5. There is obviously great need for knowledge on the residues of famine and malnutrition in the many areas of the world where severe food shortages are recurrent or chronic. It is recommended, therefore, that systematic studies be made in these areas so as to reveal the magnitude and character of the local problems, as well as to contribute to general understanding of the effects of habitual differences in nutritional status. The sponsorship of such studies would be appropriate for international agencies like the World Health Organization, the Food and Agriculture Organization, the International Labor Organization, and the Pan American Sanitary Bureau, as well as the local governments of the areas involved.

6. The conferees hope that the foregoing statements and recommendations will be seriously considered by the private, governmental, and intergovernmental agencies that have responsibility for developing and implementing plans and policy in regard to food and nutrition. The conferees stand ready, as individuals, to aid and support such agencies in their effort in these regards. Accordingly, it is agreed that copies of these statements and recommendations should be transmitted to the appropriate agencies and should be made available to the scientific public. Furthermore, it is recommended that these questions be considered in more detail in future conferences and discussion groups. These questions demand early and vigorous action.

Signatories present were:

J. D. Adamson, Department of Medicine, University of Manitoba, Winnipeg, Manitoba
Joseph Anderson, School of Public Health, University of Minnesota, Minneapolis
John Berkman, Section on Medicine, Mayo Clinic, Rochester, Minn.
Josef Brozek, School of Public Health, University of Minnesota, Minneapolis
A. J. Carlson, Department of Physiology, University of Chicago, Chicago, Ill.
Carleton B. Chapman, Department of Medicine, University of Minnesota, Minneapolis
J. N. Crawford, Directorate of Medical Services, Department of National Defense, Army, Ottawa, Ontario
W. J. Darby, Division of Nutrition, Vanderbilt University, Nashville, Tenn.
J. Groen, Wilhelmina Gasthuis, Amsterdam, The Netherlands
Austin Henschel, School of Public Health, University of Minnesota, Minneapolis
Paul E. Howe, Animal Husbandry Division, U. S. Department of Agriculture, Beltsville, Md.
Ancel Keys, School of Public Health, University of Minnesota, Minneapolis
Carl J. Koehn, Office of the Surgeon General, Department of the Army, Washington, D. C.
David Lubbock, Food and Agriculture Organization of the United Nations, Washington, D. C.
Georgia L. Lusk, War Claims Commission, Washington, D. C.
Charles D. May, Department of Pediatrics, University of Minnesota, Minneapolis
Irvine McQuarrie, Department of Pediatrics, University of Minnesota, Minneapolis
Olaf Mickelsen, Chronic Diseases Division, U. S. Public Health Service, Washington, D. C.
Sergius Morgulis, Department of Biochemistry, University of Nebraska, Omaha
Helen T. Parsons, Department of Home Economics, University of Wisconsin, Madison
William E. Peterson, Department of Dairy Husbandry, University of Minnesota, St. Paul
B. E. Rice, Research Laboratories, Swift & Company, Chicago, Ill.
Martin H. Roepke, Department of Veterinary Medicine, University of Minnesota, St. Paul
Max O. Schultze, Division of Agricultural Biochemistry, University of Minnesota, St. Paul
Ernst Simonson, School of Public Health, University of Minnesota, Minneapolis
C. Joseph Stetler, War Claims Commission, Washington
Henry Longstreet Taylor, School of Public Health, University of Minnesota, Minneapolis
Richard L. Varco, Department of Surgery, University of Minnesota, Minneapolis
Richard W. Vilter, Department of Internal Medicine, University of Cincinnati, Cincinnati, Ohio
Maurice B. Visscher, Department of Physiology, University of Minnesota, Minneapolis
Cecil J. Watson, Department of Medicine, University of Minnesota, Minneapolis
Russell M. Wilder, Division of Medicine, Mayo Clinic, Rochester, Minn.
James R. Wilson, Council on Foods and Nutrition, American Medical Association, Chicago, Ill.

The following individuals were unable to attend the conference in person but have examined this statement and have expressed their adherence to it:

F. G. Boudreau, Milbank Memorial Fund, New York City
C. A. Elvehjem, Graduate School, University of Wisconsin, Madison
Hugues Gounelle, Centre de Recherches de l'Hopital Foch, Paris, France
C. G. King, The Nutrition Foundation, New York City
L. Bradley Pett, Department of National Health and Welfare, Ottawa, Ontario
Herbert Pollack, Committee on Therapeutic Nutrition, National Research Council, Washington, D. C.
Harold R. Sandstead, Nutrition Branch, U. S. Public Health Service, Washington, D. C.
Elmer L. Sevringhaus, Division of Clinical Research, Hoffman La Roche, Inc., Nutley, N. J.
G. Cullen Thomas, Executive Offices, General Mills, Inc., Minneapolis, Minn.

Additional signatories:

W. R. Aykroyd, Nutrition Division, Food and Agriculture Organization of U. N., Washington, D. C.
John Beattie, Physiological Laboratory, Cambridge University, Cambridge, England
H. M. Sinclair, Laboratory of Human Nutrition, Oxford University, Oxford, England

About People

Robert W. Berliner has been appointed chief of the Laboratory and Clinical Section on Kidney and Electrolyte Metabolism of the National Heart Institute. Dr. Berliner will be in charge of research studies on kidney function and its relationship to the development of heart failure. He was formerly assistant professor of medicine at Columbia University.

Donald E. Gregg, chief research physician at the Army's Medical Field Research Laboratory at Fort Knox, Ky., since 1946, will head the new Department of Cardiovascular Physiology at the Army Medical Department Research and Graduate School in Washington, D. C.

Ellery H. Harvey, formerly with Sun Chemical Company, New York City, has been appointed professor of food technology at Illinois Institute of Technology. Dr. Harvey will direct sponsored research and graduate studies in food engineering.

E. Herndon Hudson, director of the Ohio University Health Service since 1940, has been named director and chief medical adviser of a WHO project in Iraq on the study and treatment of bejel (syphilis), a disease prevalent among children in that country. Dr. Hudson, an authority on tropical diseases, has been given a year's leave of absence from his university post.

Norman H. Jacobson, industrial press supervisor for Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has been appointed technical information officer for the AEC's Technical Information Service in Washington, D. C. Mr. Jacobson will be responsible for providing information to industrial periodicals. The commission plans to utilize the national trade publications in expanding its program of interpreting technological developments in AEC projects for possible application to the needs of American industry.

Irvin Levin has been appointed head of the new Biophysical Instrumentation Department, Army Medical Department Research and Graduate School, in Washington, D. C. Dr. Levin has been research associate in physical chemistry at the University of Maryland, where he has been conducting studies on the photovoltaic behavior of organic substances in solution. He expects to continue his research and to apply the results to a study of catalytic photosensitization.

George H. C. McKeown has been appointed medical administrator in the Medical Division of Sharpe & Dohme, to succeed **J. William Crosson**, who has resigned. Dr. McKeown has been assistant medical director with Ayerst, McKenna & Harrison, of New York City.

Visitors

Recent visitors at the National Bureau of Standards were: **André Durand**, professor of mathematics, University of Paris, and editor of the University's *Journal of Mathematics*; **Alidol Khalili**, director, Material Testing Laboratory, University of Teheran, Iran; **John P. O'Donnell**, lecturer, Mechanical Engineering Department, University College, Dublin; **Frederik Sixma**, assistant professor of organic chemistry, Laboratory for Organic Chemistry, University of Amsterdam; **R. Uenishi**, director of engineering, Shimadzu Seisakusho, Ltd., Kyoto, Japan; and **K. Wadati**, director, Central Meteorological Observatory of Japan, Tokyo.

Jean Delville, chief of the Laboratoire de Bacteriologie, Elizabethville, Belgian Congo, will be at the Army Medical Department Research and Graduate School, Army Medical Center, Washington, D. C., for several months, studying virus and rickettsia diagnostic techniques and working on the identification of some new viruses which he isolated in the Belgian Congo. He has been sent to the U. S. by the Belgian government's Colonial Office. **José Carlos de Melo Falcao Neto**, of the Brazilian Army Medical Corps, began a 6-months' training period at the Virus and Rickettsial Disease Laboratory, September 22.

Grants and Awards

Donald Wyman, of the Arnold Arboretum of Harvard University, has been presented with the first **Norman Jay Colman Award** of the American Association of Nurserymen at their annual convention in Washington. The award is made by the Association for Horticultural Progress and is named after the first U. S. secretary of agriculture. It was awarded to Dr. Wyman for the research work done in conjunction with ornamental woody plants and published in his book *Shrubs and Vines for American Gardens.*

The Edward Goodrich Acheson Medal and Prize has been awarded to George W. Vinal, chief of the National Bureau of Standards Division of Electrochemistry and dean of the NBS staff. The award, a gold medal and $1,000, is conferred biennially for the most outstanding contribution in the fields of activity fostered by the Electrochemical Society. It will be presented to Dr. Vinal at a banquet in his honor during the society's fall meeting in Buffalo, October 11–14.

The Raymond F. Longacre Award for 1949 has been presented to Sir Charles Symonds by the Aero Medical Association of America. The award is given annually by the association to the person who has contributed most to the advancement of neuropsychiatric aspects of aviation medicine, including the development of aptitude tests for flying. The first award was presented to Ross A. McFarland in 1947, and the award for 1948 was made to Detlev W. Bronk.

The 1951 Medal of Honor of the Institute of Radio Engineers has been awarded to Vladimir K. Zworykin, electronics scientist of the RCA Laboratories at Princeton, N. J. Dr. Zworykin's early work in electronics contributed to the development of the electronic scanning method used in television.

Radio Corporation of American fellowships have been awarded to 16 predoctoral students in fields related to radio, television, and electronics.

New grants for resident fellowships were made to Columbia University for Gardiner L. Tucker, studying under I. I. Rabi; to Princeton University for Thomas R. Williams, under C. H. Willis; and to Cornell University for Hamilton Barhydt, under Lloyd P. Smith. New RCA fellowships administered by the National Research Council were given to Andrew R. Hutson, to study problems of electron emission at MIT; John G. Meeker, for research in electron dynamics at the University of Michigan; Hilliard M. Wachowski, for theoretical research on microwaves and antennas at Northwestern University; and George E. Zenk, for vacuum tube amplifier network analysis at Carnegie Institute of Technology. The new fellowship to an RCA employee went to Irwin E. Goldstein, for study at the University of Pennsylvania.

Fellowships and Prizes

The Arthritis and Rheumatism Foundation is offering fellowships for research in the basic sciences related to the study of arthritis. The fellowships provide stipends of $4,000 to $6,000 for a year, beginning July, 1951. Applications should be sent to the foundation at 535 Fifth Ave., New York 17, by *January 1.*

An annual award for research in antibiotics has been established by the Commercial Solvents Corporation, to be administered by the Society of American Bacteriologists. The award of $1,000 and a gold medal will be given to an individual or a group in the Western Hemisphere working particularly in basic research contributing to fundamental knowledge about antibiotics. Further information may be obtained from the secretary, Society of American Bacteriologists, Hospital for Joint Diseases, 1919 Madison Ave., New York 35.

The Educational Testing Service is offering two research fellowships leading to the Ph.D. in psychometrics, at Princeton University. The fellowships, carrying a stipend of $2,375 a year, are open to men acceptable to the Graduate School of the university. Competence in mathematics and psychology is required. Fellows will engage in part-time research in the general area of psychological measurement at the offices of the service and will carry a normal program of studies at Princeton. Applications must be submitted before *January 19, 1951.* Information may be obtained from Director of Psychometric Fellowship Program, Educational Testing Service, 20 Nassau St., Princeton, N. J.

The School of Mathematics of the Institute for Advanced Study will allocate a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do research work at Princeton during the academic year 1951–52. Candidates must give evidence of ability in research comparable at least with that expected for the Ph.D. degree. Application blanks may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, N. J., and are returnable by *January 1, 1951.*

The American Urological Association offers annual awards of $1,000 (first prize $500, second prize $300, third prize $200) for essays on the result of clinical or laboratory research performed by urologists who have been in such specific practice not more than 5 years or by men in training. The first prize essay will appear on the program of the annual meeting of the association, to be held in Chicago, May 21–24, 1951. Further information may be obtained from Dr. Charles H. de T. Shivers, Secretary, Boardwalk National Arcade Building, Atlantic City, N. J. Essays must be submitted by *February 10, 1951.*

The American College of Chest Physicians is offering an annual international award of $250 for the best original paper on any chest disease. Five copies of the manuscript should be submitted not later than *April 1, 1951,* to the executive office of the college, 500 North Dearborn St., Chicago 10. Further information may be had from the secretary.

Colleges and Universities

Recent appointments in the **University of Colorado Department of Medicine** include Archibald R. Buchanan, professor of anatomy at Colorado since 1946, as assistant dean; Raymond R. Lanier, of the University of Chicago Clinics, as professor and head of the Department of Radiology; Cosmo G. Mackenzie, of Cornell University Medical College, as professor and head of the Department of Biochemistry; and J. Cotter Hirschberg, professor of psychiatry at Colorado, as director of the Mental Hygiene Clinic.

The University of North Carolina School of Medicine has made the following appointments to its staff: Thomas C. Butler, formerly associate professor of pharmacology and experimental therapeutics, Johns Hopkins University, professor and head of the Department of Pharmacology; J. Logan Irvin and Carl E. Anderson, associate professors of biological chemistry; John E. Wilson, assistant professor of biological chemistry; George P. Manire, assistant professor, and Milton Huppert, instructor in bacteriology; Jack H. Brown, assistant professor of physiology; James A. Green and Harold F. Parks, instructors in anatomy; and J. Henry Smith Fousbee, Jr., fellow in pathology.

The University of Southern California's Department of Chemistry is now headed by Robert D. Vold, who succeeds Anton B. Burg. Dr. Burg has resigned in order to devote more time to research projects sponsored by the Office of Naval Research, including the organization and editing of an advanced treatise on inorganic chemistry. Jerome A. Berson, former research fellow at Harvard, has been appointed assistant professor of chemistry in the department.

Wayne University College of Medicine has appointed Fred L. Rights professor and chairman of the Department of Microbiology. Dr. Rights comes to Detroit from Chapel Hill, N. C., where he has been associate professor of bacteriology at the University of North Carolina.

Ernest Dean Gardner has been named professor of Anatomy and head of the department, replacing **Gordon H. Scott** who resigned as chairman of the Anatomy Department to assume the deanship of the College of Medicine. Dr. Scott will continue as professor of anatomy. Dr. Gardner is known for his many contributions in the field of joint innervation and physiology, and other aspects of neurophysiology.

Meetings

The international meeting of the **Division of Rubber Chemistry, American Chemical Society,** will be held in Cleveland, Ohio, October 11–13. Twenty-five technical papers will be given by distinguished rubber technologists from England, France, Holland, Italy, Sweden, Malaya, and Java; 20 papers will be presented by this country's rubber chemists.

A formal dedication and open house will be held at the new quarters of the Virginia Fisheries Laboratory at Gloucester Point, Va., on October 12 from 2:00 to 5:00 P.M., to be followed by a two-day scientific meeting—sponsored by the **Atlantic Estuarine Research Society**—featuring a symposium on estuarine ecology. R. E. Coker, University of North Carolina, and Waldo Schmitt, U. S. National Museum, will serve as co-chairmen of the symposium, and participants will include many outstanding men in the field. Those interested in attending the scientific sessions should write the Virginia Fisheries Laboratory immediately for reservations (rates, $1.75–$2.50 per person per night).

The National Society for Crippled Children and Adults will hold its annual convention October 26–28 at the Stevens Hotel in Chicago. Delegates from more than 2,000 state and local affiliates of the society in the 48 states, District of Columbia, Alaska, Hawaii, and Puerto Rico will obtain up-to-date knowledge of the society's program of education, research, and direct services. The meeting is open to the public, and an attendance of 5,000 is expected.

An institute on administration of scientific research and development will be presented by The American University, October 23–27, with the cooperation of the National Research Council and the AAAS. Formal registration will take place October 23, at 9:00 A.M., in the Office of the Registrar, School of Social Sciences and Public Affairs, 1901 F St., N.W., Washington, D. C. Those engaged in the administration of research and its application are eligible; others may be admitted with permission of the institute director. Applications will be accepted in the order in which they are received, and not more than 35 persons will be enrolled.

The program will be devoted to problems of research organization, administrative process in the research organization, research personnel, aids to research, and research product. Lectures by practitioners in government, industry, universities, and private foundations will present their findings in each of the topics on the program. In some instances a panel of experts will offer different points of view. Both students and speakers will participate in the discussion to follow each presentation. An advance registration fee of $10 will be credited to tuition charges of $35. Application should be made to Lowell H. Hattery, The American University, 1901 F St., N.W., Washington 6, D. C.

Miscellaneous

Postgraduate training in orthopedic surgery will be given at the Hospital for Joint Diseases, New York City, in cooperation with Columbia University College of Physicians and Surgeons, from September 28 to December 14. The course, to be held on consecutive Thursdays, will include lectures, case demonstrations, conferences on the clinical, diagnostic, therapeutic, pathologic, bacteriologic, and chemical aspects of skeletal disease, presenting a review of the modern concept of the more important orthopedic diseases. Opportunities will be provided for clinical examination of patients. Applications for registration should be made to the Assistant Dean, Graduate Medicine, Columbia University College of Physicians and Surgeons, 630 West 168th St., New York 23.

Security, Loyalty, and Science, by Walter Gellhorn, of Columbia University Law School, has recently been published by Cornell University Press. This report is the first of eight to be issued in a Cornell study of the impact on civil liberties of current governmental practices intended to ensure security and the control of subversive conduct. The two-year project is being conducted as part of the university's "Research in Civil Liberties," under the direction of Robert E. Cushman, and has the financial support of the Rockefeller Foundation.

Existence of tritium, heavy radioactive isotope of hydrogen, in heavy water, has been announced by Willard F. Libby, of the University of Chicago, and A. V. Grosse, of Temple University. Source of the tritium is the action of cosmic rays in the upper atmosphere. The tritium is carried in minute quantities to the earth's surface by rain, and collects in bodies of water. Its discovery may permit the tracing of the vertical motion of bodies of water, for the tritium is introduced at the surface of lakes and oceans. The amount of tritium at various levels could determine the length of time required for water to reach lower levels.

Deadline for the receipt of entries in the Fourth Annual Photography-in-Science Salon, sponsored by *The Scientific Monthly* (a publication of the AAAS) and the Smithsonian Institution, is *November 27.* Laboratory directors, graduate students, and other scientists doing significant work in which photography is an important tool are urged to write for information and entry blanks to the Editor, The Scientific Monthly, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

WILEY

New Material for Mathematicians, Lumber Men, Physicists, and Chemists—

MATHEMATICS of RELATIVITY

By G. Y. Rainich, *University of Michigan.* Presents the theory of relativity in as simple a form as is consistent with the clarity of the fundamental concepts. In order to present the theory of relativity with maximum clarity, the mathematical aspect of the subject has been stressed. The book begins with a discussion of the inverse square law in terms of simple calculus. The more complicated situations are introduced step by step to bring in gradually the more sophisticated mathematical tools. Changes in fundamental concepts and the refinements of the mathematical technique are brought in only as they are needed. This system makes the presentation easier by separating the difficulties without sacrificing rigor. A book in the APPLIED MATHEMATICS SERIES, I. S. Sokolnikoff, editor. *September 1950. 173 pages. $3.50.*

FOREST PRODUCTS

By Nelson C. Brown, *Syracuse University.* A book of importance to anyone interested in the harvesting, processing, and marketing of materials other than lumber, including the principal derivatives, extractives, and incidental products in the U. S. and Canada. Covered are such product developments as the use of wood pulp for rayon, wood sugars, plastics, and clothing; veneers, plywood, pulp and paper products, densified or modified wood, Silvacon, and many chemical products; wood briquettes, linoleum floor coverings, wallboards, and other materials from wood paste. *September 1950. 399 pages. 164 illus. $5.00.*

RESPONSE of PHYSICAL SYSTEMS

By John Trimmer, *University of Tennessee.* This book on instrumentation and the measurement process shows how to use mathematical techniques on physical systems. Closely linked with cybernetics, this general study includes in its domain not only physical systems but biological and sociological entities as well. Throughout the work, philosophy and point of view are emphasized. Examples of physical systems are plentiful, diverse, and chosen with particular regard for subject and interest. *August 1950. 268 pages. 94 illus. $5.00.*

A GERMAN-ENGLISH DICTIONARY for CHEMISTS

Third Edition. By Austin M. Patterson, *Asst. Editor, "Chemical Abstracts."* Increased to about 59,000 terms, this third edition features additions in chemical technology, electronics, and warfare. The general vocabulary has many non-technical terms often found in chemical literature. An introduction explains the peculiarities of German nomenclature. Prefixes and suffixes receive extra attention, giving great help in translating unusual words. *1950. 541 pages. $5.00.*

Send for copies on approval.

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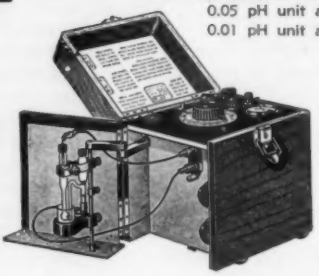

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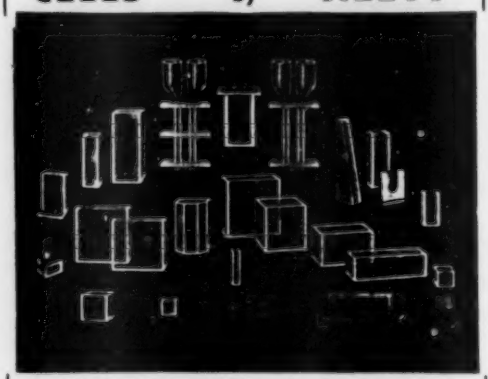

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The list of names below is a photographic copy of the upper portion of page 673 of the DIRECTORY. It illustrates the ease with which a name can be found.

MEMBERS' AND FELLOWS 673

M

Ma, Frederick; M40R40; CN.

Ma, Roberta; P. O. Box 825, Berwyn, Md.; *Botanical Sciences*; M46F47; G.

Ma, T. S.; Dept. chemistry, National Peking Univ., Peiping, China; *Chemistry, Medicine*; M44; CN.

Maag, O. L.; Timken Roller Bearing Co., Canton, Ohio; *Chemistry, Engineering*; M42; CM.

Maas, Philip; Hahnemann Medical Coll., 235 North 15th St., Philadelphia, Pa.; *Chemistry, Medicine*; M42; CN.

Maaske, Clarence A.; Univ. Colorado, Hosp. and Med. Sch., 4200 E. Ninth Ave., Denver, Colo.; *Medicine, Education*; M46F47; NQ.

Mabbott, Thomas O.; M44R44; L.

Marby, Roger; M38R40.

MacAdam, D. J., Jr.; M18F26R45; MB.

MacAfee, Jerry; M45R45; CM.

MacAfee, William Keith (1893); Box 300, Redlands, Calif.; B.S. Univ. Pennsylvania; *Ceramic Engineering*; Pres., Universal Sanitary Mfg. Co., Redlands; M34-F34L43; MB.

MacAlister, Dean Ferdinand (1910); Ph.D. Univ. Wisconsin; *Plant Physiology*; Assoc. physiologist, div. forage crops, U. S. D. A.; U. S. Regional Soybean Lab., 205 Old Agr. Bldg., Urbana, Ill.; M37F39; G.

MacAlister, Edward Dorris (1901); Brightford Hgts., Rochester, N. Y.; Ph.D. Univ. California; *Physics, Rdiation*; Chief engr. instrumentation camera works, Eastman Kodak Co., Rochester; (M37F38R40)M47F38; BM.

McAmis, J. C.; Tennessee Valley Authority, Knoxville, Tenn.; *Agriculture, Botanical Sciences*; M47; OG.

McArdle, Edward H.; M42R42; C.

MacArthur, C. G.; Bowmansville, N. Y.; *Chemistry, Medicine*; M28F33; CN.

MacArthur, Edith Helena (1892); R. D. 1, Fort Ann, N. Y.; Ph.D.; *Chemistry, Nutrition*; Prof. and chrmn., dept. home economics, Skidmore Coll., Saratoga Springs; N. Y.; M29F33; CN.

MacArthur, John Wood (1889); 200 Glencairn Ave., Toronto, Ont., Canada; Ph.D. Univ. Chicago; *Genetics*; Prof. genetics, dept. Zoology, Univ. Toronto, Toronto, M13F15; FG.

McArthur, Selim Walker (1888); 122 S. Michigan Ave., Chicago, Ill.; M.D. Univ. Chicago; *Surgery*; Assoc. prof. surgery, Univ. Illinois and sr. attending surgeon, St. Lukes Hosp., Chicago; M42; NF.

McAtee, Vevа; M38R38; FG.

McAuley, Auley A.; Miami Univ.; Oxford, Ohio; *Zoology Sciences*; M48; F.

McAuliffe, Gervais Ward (1896); 630 Park Ave., New York, N. Y.; M.D. Long Island Coll. Medicine; *Otolaryngology*; Assoc. prof. otolaryngology, Cornell Univ., New York; M44; N.

McAvoy, Blanche (1885); 108 W. Ash St., Normal, Ill.; Ph.D. Univ. Chicago; *Ecological Botany*; Assoc. prof. biology, Illinois State Normal Univ.; M21F33; G.

McBain, James William (1882); 571 Foothill Rd., P. O. Box 1408, Stanford Univ., Calif.; Ph.D. Univ. Leipzig, Germany; *Chemistry*; Prof. chemistry, Stanford Univ.; M28F32; CB.

This particular part of page 673 is chosen because it contains brief examples of nearly all types of biographical sketches. The first item is the name of a person who was a member only one year. The next to the last name in the first column includes the usual biographical sketch; the subject was born in 1910, took his doctor's degree at Wisconsin; his specialty is *Plant Physiology;* he became a member of the Association in 1937, a fellow in 1939, and is affiliated with the Section on Botanical Sciences (G).

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